

# VERIFICATION REPORT FOR RECAST ENERGY LOUISVILLE FUEL SWITCH FROM COAL TO BIOMASS FOR THERMAL ENERGY



Document Prepared By NSF Certification LLC

|                      |                                                                              |
|----------------------|------------------------------------------------------------------------------|
| <b>Project Title</b> | Recast Energy Louisville Fuel Switch From Coal to Biomass for Thermal Energy |
| <b>Version</b>       | 1.0                                                                          |
| <b>Report ID</b>     | V1680823                                                                     |

|                            |                                                                                                      |
|----------------------------|------------------------------------------------------------------------------------------------------|
| <b>Report Title</b>        | VERIFICATION REPORT FOR RECAST ENERGY LOUISVILLE FUEL SWITCH FROM COAL TO BIOMASS FOR THERMAL ENERGY |
| <b>Client</b>              | Recast Energy Louisville, LLC                                                                        |
| <b>Pages</b>               | Page 1 of 22                                                                                         |
| <b>Date of Issue</b>       | 15 October 2018                                                                                      |
| <b>Prepared By</b>         | NSF Certification LLC                                                                                |
| <b>Contact</b>             | 759 N Dixboro Road, Ann Arbor, MI 48105 USA, +1 (734) 769.8010, sustainability@nsf.org               |
| <b>Approved By</b>         | Tina Sentner                                                                                         |
| <b>Work Carried Out By</b> | Michael DeBusschere                                                                                  |

**Summary:**

The Recast Energy Louisville Fuel Switch From Coal to Biomass for Thermal Energy Project (the Project) is a thermal energy generation project fueled with locally available forestry and agricultural cellulosic residues (i.e., primary mill residues, logging residues, and crop residues), and is located at the Lubrizol Advanced Material, Inc. facility in Louisville, Kentucky (the Facility). The Project location is on land owned by one of the project customers (Lubrizol) and then subsequently leased back to the Project Proponent, Recast Energy Louisville, LLC. The Project is owned and operated by Recast Energy Louisville, LLC. Thermal energy from the biomass system displaces thermal energy generated by the coal-fired boiler system. The thermal energy generated from the biomass boiler is sold to Lubrizol and Zeon Chemicals (the project customers). The pre-project scenario consisted of the project customers receiving thermal energy that was generated by coal and supplemented with natural gas when needed. The Project achieves GHG emission reductions by displacing thermal energy that would have been generated from the Boiler #4 fossil fuel boiler. The Project's crediting period is April 1, 2013 through March 31, 2023.

The purpose of verification was to ensure the Project was implemented in accordance with the criteria stated below and meets the requirements of the Verified Carbon Standard (VCS) program.

The verification process consisted of the independent third-party assessment of the Project design implementation and emission reduction assertion against the criteria stated in the VCS Version 3, June 21, 2017, v3.7 and the approved Clean Development Mechanism (CDM) methodology AMS-I.C. "Thermal energy production with or without electricity" Version 19, June 17, 2011.

This Verification Report covers the reporting period January 1, 2015 through December 31, 2017, for three vintage calendar years. During the verification process, NSF issued Ten clarification requests and no corrective action requests – all of which were addressed sufficiently by Recast Energy, LLC.

On the basis of work conducted, NSF was able to conclude with reasonable assurance that the Recast Energy Louisville Fuel Switch From Coal to Biomass for Thermal Energy Project asserted vintage emission reductions of 56,331 tonnes of CO<sub>2</sub>-e in calendar year 2015, 49,922 tonnes of CO<sub>2</sub>-e in calendar year 2016, and 53,362 tonnes of CO<sub>2</sub>-e in calendar year 2017 were accurately stated and met all relevant VCS Version 3 requirements and correctly applied the VCS-approved CDM methodology AMS-I.C.

## Table of Contents

### TABLE OF CONTENTS

|                                                  |    |
|--------------------------------------------------|----|
| Table of Contents .....                          | 3  |
| 1 Introduction .....                             | 5  |
| 1.1 Objective .....                              | 5  |
| 1.2 Scope and Criteria .....                     | 5  |
| 1.3 Level of Assurance.....                      | 6  |
| 1.4 Summary Description of the Project .....     | 6  |
| 2 Verification Process .....                     | 6  |
| 2.1 Method and Criteria.....                     | 6  |
| 2.2 Document Review .....                        | 8  |
| 2.3 Interviews .....                             | 9  |
| 9                                                |    |
| 2.4 Site Inspections.....                        | 9  |
| 2.5 Resolution of Findings.....                  | 10 |
| 2.5.1 Forward Action Requests.....               | 10 |
| 2.6 Eligibility for Validation Activities .....  | 10 |
| 3 Validation Findings.....                       | 10 |
| 3.1 Participation under Other GHG Programs ..... | 10 |
| 3.2 Methodology Deviations .....                 | 10 |
| 3.3 Project Description Deviations .....         | 12 |
| 3.4 Grouped Project .....                        | 12 |
| 4 Verification Findings.....                     | 12 |
| 4.1 Project Implementation Status .....          | 12 |

|             |                                                                             |    |
|-------------|-----------------------------------------------------------------------------|----|
| 4.2         | Accuracy of GHG Emission Reduction and Removal Calculations .....           | 14 |
| 4.3         | Quality of Evidence to Determine GHG Emission Reductions and Removals ..... | 17 |
| 4.4         | Non-Permanence Risk Analysis.....                                           | 18 |
| 5           | Safeguards.....                                                             | 18 |
| 5.1         | No Net Harm .....                                                           | 18 |
| 5.2         | Local Stakeholder Consultation .....                                        | 18 |
| 6           | Verification conclusion .....                                               | 18 |
| 6.1.1       | Verification Summary: .....                                                 | 19 |
| APPENDIX A: | Findings .....                                                              | 21 |

## 1 INTRODUCTION

### 1.1 Objective

The objective of this verification was to determine conformance with the criteria as noted below and confirm that the emission reductions reported are accurate, complete, consistent, transparent and free of material error for the Recast Energy Louisville Fuel Switch from Coal to Biomass for Thermal Energy Project (the Project), located in Louisville, Kentucky. NSF Certification LLC (NSF) conducted the verification following the criteria listed below and per the Validation Report as conducted for the Project in 2015.

### 1.2 Scope and Criteria

This report covers the verification of greenhouse gas (GHG) emission reductions achieved by displacing thermal energy that would have been generated from a fossil fuel boiler over the period from January 1, 2015 through December 31, 2017. The project boundary Scope consisted of the following:

#### *Baseline Sources*

- Emission reductions of CO<sub>2</sub> resulting from displacement of fossil fuel (coal) consumption

#### *Project Sources*

- CO<sub>2</sub> emissions from on-site consumption of diesel fuel in equipment used to move wood fuel within the facility.
- CO<sub>2</sub> emissions from electricity consumption by the project activity in excess of the electricity used by the boiler prior to the activity

#### *Leakage*

- CO<sub>2</sub> leakage emissions from the offsite transportation and processing of biomass residue

The criteria used for this verification were:

- VCS Standard v 3.7 dated June 21, 2017 and associated updates and clarifications
- VCS Program Guidelines v 3.7 June 21, 2017
- CDM AMS I.C. "Thermal energy production with or without electricity" v 19 June 17, 2011, and associated updates and methodological tools as applicable to the Project such as clarification SSC573 July 28, 2011, SSC675 February 14, 2013, and SSC676 February 14, 2013 (per the Validation). , and the following CDM approved methodological tools and guidance documents:

- tool to calculate the emission factor for an electricity system, Version 04.0.0;
  - tool to calculate baseline project and/or leakage emissions from electricity consumption, Version 1.0;
  - tool to calculate project or leakage CO<sub>2</sub> emissions from fossil fuel combustion, Version 2.0;
  - Guidelines on the Demonstration of Additionality of Small-Scale Project Activities, Version 09.0;
  - General Guidelines to SCC CDM methodologies, Version 20;
  - General guidance on leakage in biomass project activities, Version 03;
  - Annex 18, Definition of Renewable Biomass
- ISO 14064:2006 Part 3, Greenhouse gases – Specification with guidance for the validation and verification of greenhouse gas assertions.

### 1.3 Level of Assurance

A reasonable level of assurance was attained for this verification.

### 1.4 Summary Description of the Project

The Project is a thermal energy generation project fueled with locally available forestry and agricultural cellulosic residues (i.e., primary mill residues, logging residues, and crop residues), and is located at the Lubrizol Advanced Material, Inc. facility in Louisville, Kentucky (the Facility). The Project location is on land owned by one of the project customers (Lubrizol) and then subsequently leased back to the Project Proponent, Recast Energy Louisville, LLC. The Project is owned and operated by Recast Energy Louisville, LLC. Thermal energy from the biomass system displaces thermal energy generated by the coal-fired former Lubrizol Boiler #4. The thermal energy generated from the biomass boiler is sold to Lubrizol and Zeon Chemicals (the project customers) adjacent to the Facility. The pre-project scenario consisted of the project customers receiving thermal energy from Lubrizol Boiler #4 generated by combustion of coal, supplemented with natural gas when needed. The Project does not combust coal or natural gas, its sole fuel being biomass with occasional startup diesel oil. The Project achieves GHG emission reductions by displacing thermal energy that would have been generated from the former Lubrizol Boiler #4 fossil fuel boiler with thermal energy produced using biofuel.

The Project's crediting period is April 1, 2013 through March 31, 2023. The project start date established as per the Validation as December 10, 2012.

## 2 VERIFICATION PROCESS

### 2.1 Method and Criteria

NSF conducted its verification of the reported emission reductions in accordance with ISO 14064:2006 Part 3. The following is a summary of the verification process implemented by NSF:

- Conflict of Interest review;
- Selection of Audit Team;
- Kick-off meeting with Recast Energy Louisville, LLC ( Recast Energy);
- Review of the VCS Project Description and Validation Report,

- Development of the verification plan and sampling plan;
- Document review and evaluation of raw data, calculations, and supporting documentation for the period under review;
- Follow-up interaction with Recast for corrective action, clarification, or supplemental data as needed; and
- Final statement and report development.

The verification was performed in accordance with the requirements of the criteria listed above.

Prior to the beginning of this verification, NSF conducted an evaluation to identify any potential conflicts of interest associated with the project. No potential conflicts were found for this Project.

NSF utilized a qualified team of professionals to perform this verification. The lead verifier was Michael DeBusschere, P.E. and the Internal Reviewer was Tina Sentner. Both are qualified lead GHG Verifiers.

The verification audit was initiated with a kick-off conference call on August 30, 2018 between NSF and Recast Energy. The communication focused on confirming the verification scope, objectives, criteria, schedule, and the data required for the verification.

### ***Initial Desk Review***

The Audit Team reviewed the Project Description (PD) and Validation Report as a basis for developing the verification plan. A detailed discussion is provided below regarding the document review for the Project.

### ***Development of the Verification Plan and Sampling Plan***

NSF developed and documented its verification plan as well as determined the data-sampling plan subsequent to the kick-off call. The verification plan was developed based on review of the PD and Validation Report along with a discussion of key elements of the verification process during the kick-off meeting. The Project Proponent was given the opportunity to comment on key elements of the plan for verification. Based on items discussed and agreed upon with the Project Proponent, the level of assurance, materiality threshold, and standards of evaluation and reporting for the verification were finalized. NSF also provided an outline of the verification process and established project steps and a tentative schedule for completion of the verification to the Project. A separate sampling plan was designed to review all project elements in areas of low, medium and high risk of inaccuracy or non-conformance.

### ***Site Visit***

NSF performed a site visit on September 4, 2018. The site visit included interviews with relevant site personnel and project stakeholders; review of the Project's operations; data collection procedures and information management systems; as well as assessments of the Project's controls for sources of potential errors and omissions. The site inspection included a tour of the

entire Project facility including the fuel material receiving yard, Project Boiler No. 4, Ash Handling unit, and all associated ancillary equipment (i.e., metering and data recording systems), and process areas.

### ***Quantitative Review***

The Audit Team performed an assessment of the Monitoring Report, GHG emission reduction assertion, and supporting documentation, as further described in Sections below.

### ***Corrective Actions and Supplemental Information***

The Audit Team issued requests for supplemental information, corrective action, and clarification during the verification process. The corrective action and clarification requests and the responses provided by the Project are summarized in the appendix.

### ***Verification Reporting***

Verification reporting documents the verification process and identifies its findings and results. Verification reporting consisted of this report and a separate Deed of Representation to be submitted to the Verra organization.

## **2.2 Document Review**

NSF performed a document review following approval of a low conflict of interest potential for NSF and members of the verification team. A first document review was performed in accordance with a verification plan issued initially on September 1, 2018, and subsequently revised on September 16, 2018. The following documents were included in the initial document review:

- Recast Energy Louisville Fuel Switch From Coal to Biomass Project Description Report Validation Report for Recast Energy Louisville Fuel Switch from Coal to Biomass for Thermal Energy
- Recast Energy Louisville Fuel Switch From Coal to Biomass for Thermal Energy Monitoring Report 12015, 2016 and 2017 assertions in PDF or Excel
- Documentation of project boundaries (geographic, pollutants to be reported, and Scopes to be reported) for the assertion years
- GHG reporting & monitoring Management Plan
- Copies of previous project validation and verifications for the 2014 assertion
- Site specific electrical and natural gas use information for each year (copies of electric and gas bills) and explanation of how this data was annualized for calendar years
- Records used for fuel supply mobile source fleet emissions
- Copies of procedures and work instructions, to the extent they are relevant, of data management system and environmental management system if not already included in the GHG Management Plan documentation
- Explanation for any changes in GHG emissions greater than 5% reported to VCS between calendar year 2014 and 2015
- Any updates to definitions and heat content of boiler fuels, and the emission factor used for these fuels in calculating reductions. Default factors for wood fuels and the data used to normalize to default heat values.

- Emission source testing summaries year to year, and the air emissions operating permit and emission reports for the assertion years

The following additional information was received as a result of the on-site meeting and document review conducted during the verification:

- Detailed spreadsheets for 2015 & 2016 enthalpy production
- An updated Monitoring Report(s)
- DCS data summaries for three months of each report year
- DCS Screen Shots of monthly summaries
- Truck scale calibration documentation
- Steam invoices and comparison steam receipts by Lubrizol and Zeon to corroborate thermal production for baseline calculations
- A picture of Boiler #4's boiler plate
- Contract documentation for Project emission reduction credit ownership
- Attestation to the VCS that asserted emission reduction credits have not been applied for to any other crediting body

## 2.3 Interviews

Through the course of verification activities, NSF interviewed the following project personnel on-site September 4, 2018 to inform the verification process:

- Donna Wirick, Recast Environmental Manager, Richmond, VA
- Thomas Harper, Louisville Plant Boiler Operator
- Jamie Howell, Louisville Plant Manager

Subsequent interviews occurred with Ms. Wirick to clarify and/or obtain additional information regarding the verification. The purpose of the interviews were to assess and confirm information an data provided in the PD and monitoring report, and identify relevant competencies to assigned roles and responsibilities.

## 2.4 Site Inspections

NSF performed a site visit on September 4, 2018. The site visit included interviews with relevant site personnel and project stakeholders; review of the Project's operations; data collection procedures and information management systems; as well as assessments of the Project's controls for sources of potential errors and omissions. The site inspection included a tour of the entire Project facility including the fuel material receiving yard, Project Boiler No. 4, Ash Handling unit, and all associated ancillary equipment (i.e., metering and data recording systems), and process areas. Inspection of the steam metering equipment was not practical as it was located atop inaccessible building structure.

The following topics were discussed with Project personnel during the site visit:

- The implementation status of the project activities
- Were there any material discrepancies between project implementation and the project description, and also were there any material discrepancies between the actual

monitoring system, and the monitoring plan set out in the project description and the applied methodology

- Confirm implementation status of the monitoring plan and the completeness of monitoring
- Discuss how the implemented monitoring system (ie, process and schedule for obtaining, recording, compiling and analyzing the monitored data and parameters) conform to the Methodology
- Review documentation the GHG emission reductions or removals generated by the project were not included in an emissions trading program or any other mechanism that includes GHG allowance trading, or submitted to another certifying body than VCS since the initial verification
- Whether the project has participated or been rejected under any other GHG programs since validation or previous verification.
- Identify any internal documents and protocols that set guidelines for the data collection process.

The information gathered during these discussions and review was used to assess the Project's data management systems and its controls for sources of potential errors and omissions.

## 2.5 Resolution of Findings

The Audit Team issued five requests for corrective action and four requests for clarification during the verification process. Recast Energy's responses were sufficient to resolve all requests. The corrective action and clarification requests and the responses provided are summarized in the tables found in Appendix A.

### 2.5.1 Forward Action Requests

There were no forward action requests for this verification.

## 2.6 Eligibility for Validation Activities

NSF did not conduct Validation activities during this verification.

## 3 VALIDATION FINDINGS

Not Applicable – The scope of this verification does not include a gap validation, validation of methodology deviations, project description deviations, or inclusion of new project activity instances into grouped projects.

### 3.1 Participation under Other GHG Programs

Not Applicable – The project is not seeking registration with any other GHG programs.

### 3.2 Methodology Deviations

The following methodology deviations were previously approved during Validation and applied in the initial verification period and in this verification period:

**1. Parameter:**  $Q_{\text{steam}, :}$

**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 comingle mass and energy from all boilers will be used to calculate thermal energy generated by the biomass boiler alone. Recast Energy 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,  $h_{\text{steam}}$  and  $h_{\text{feedwater}}$  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:**  $EC_y$

**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:**  $EF_{\text{grid}, \text{CM}, y}$

**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:** FC<sup>Diesel, loader, y</sup>

**AMS-I.C Requirement:** Use "Tool to calculate project or leakage CO<sub>2</sub> emissions from fossil fuel combustion"

**Deviation:** Purchased fuel invoices are used to monitor the quantity of diesel fuel used to calculate the project CO<sub>2</sub> 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.

These deviations were approved during the Project Validation and initial Verification by the validation body and have not changed for this reporting period.

### 3.3 Project Description Deviations

Not Applicable - No new project description deviations were applied during the current reporting period.

### 3.4 Grouped Project

Not applicable. The project is not a grouped activity and is a sole facility project.

## 4 VERIFICATION FINDINGS

### 4.1 Project Implementation Status

The Recast Energy Louisville Fuel Switch From Coal To Biomass For Thermal Energy Project was implemented according to the Project Description (PD). For the current verification period (2015, 2016, 2017), the project operated continuously supplying steam to the project customers as needed for manufacturing operations. The normal demand for steam fluctuated with operational needs and the need for building heat during cold weather. Increases and decreases from year to year were primarily the result of fluctuations in demand for building heat for the manufacturing complex. NSF confirmed there were no changes to the project activity, proponents or other entities.

The Project start date was December 10, 2012. The 10-year project crediting period began on April 1, 2013 and ends on March 31, 2023 based on the initial report period verification. The Project's start date and crediting period were previously confirmed at validation.

#### Project Monitoring

The relevant parameters of the Project's monitoring plan are described below.

The quantity of steam generated by the Project (Boiler No. 4) was monitored by an ABB Vortex Flow meter FV4000. The flow meter was calibrated prior to initial installation on June 6, 2012 by the OEM in accordance with the manufacturer's specifications. The PD states that flow meters

will be serviced by a qualified technician at least once every three years. Steam metering was reviewed. OEM requirements for calibration of the Project steam meters to its two customers was met. The OEM requirement is to have had the initial factory calibration, which was documented in the Project Validation, followed by periodic calibrations as determined to be necessary if metering results appear to be inaccurate. To document steam meter accuracy the Project compares customer steam received metering results monthly to the Project's metering results. There were no comparison results indicating calibration was required during the reporting period.

Per interview with the Project's on-site engineer, the Boiler 4 steam flow meter was inspected in 2015 and no material variances were found in its operation. The PD requirement was met for the current reporting period. The steam and boiler feed water enthalpies were calculated from the steam pressure and boiler feed water temperature, measured by a pressure sensor (ABB pressure transducer) and temperature sensor (ABB temperature probe). Similarly, the pressure and temperature meters were last checked for calibration accuracy in early 2015 in accordance with the manufacturer's specifications confirmed by testimony of the site engineer. The PD states that these meters will be checked for accuracy at least once every three years.

The Project utilized a Rockwell International distributive control system (DCS) to record boiler operational parameters every ten seconds, and to provide hourly summaries of select operations parameters specific to GHG reduction calculations, in particular the pounds of steam generated, hours of operation and whether the boiler is operating normally. The Project team captured and summarized DCS data into spreadsheet performance reports, which were then used to create invoices to its two customers on a monthly basis.

Electricity consumption by the project activity was determined by comparing the electricity demand of Boiler No. 4 and the associated pollution control and ancillary equipment before and after the biomass conversion based on a study conducted at validation, evaluating the specifications and usage rate of the power consuming equipment. The study determined the difference in electricity usage for the project, related directly to the changes in equipment on the boiler and pollution control and ancillary equipment to combust biomass.

All other electricity uses within the facility existed prior to the conversion and would have continued at the same rate had the conversion not occurred. The study last updated in June 2015 for the current reporting period.

Fossil fuel consumption for equipment used to move biomass within the project facility was determined by fuel supplier invoices during the monitoring period.

Leakage emissions from off-site consumption of diesel fuel during the collecting and processing of biomass residues are determined from biomass delivery records. Off-site consumption of diesel fuel due to transporting of biomass residues were applicable if from more than 200km to the project site. The net biomass delivered to the facility with each load was measured by a truck scale. Delivery tickets recorded the net weight and the origin of the load and identified the distance travelled for delivery. Quality assurance and control procedures include calibration of the facility truck scale (Weigh Tronix E1310) at least annually, in accordance with manufacturer recommendation. The scale was calibrated quarterly during 2015, 2016 and 2017, documented by calibration certificates, even though the weight of biomass was not required by the Methodology to determine emission reductions. Delivery tickets were reviewed and signed by a project employee upon receipt from the truck driver, reviewed during invoice matching, and then archived. NSF reviewed a sample of biomass delivery tickets while on site and from records

submitted for document review to confirm that transportation distances were correctly accounted for.

The Project used Google Earth to document distances travelled and assumed equidistant round-trip segmentation for deliveries of 200 km or more for input into leakage calculation of fuel transportation, and also for each disposal/end use destination according to the ash delivery tickets generated during the monitoring period. Emissions from off-site consumption of diesel fuel due to transportation of ash (combustion residuals) from the Project to final disposal or beneficial use outlets were determined according to the round-trip distance to the disposal site.

No data and/or variables presented in the Monitoring Report differ from those stated in the PD, except where noted in Section 3.2 above or as described below. Similarly, the data collection and recordkeeping procedures were found to be consistent with those outlined in the monitoring plan and as described by the PD, and meet the requirements of AMS-I.C. NSF also verified the Project management and operational systems, with respect to monitoring and reporting, and found they were conformant with the verification criteria through observation during the site visit and the document review of project documentation.

Lastly, NSF confirmed during the verification process that GHG emission reduction credits had not been registered under another GHG program. Additionally, Recast Energy provided an attestation for the current reporting period, dated September 27, 2018, indicating that GHG emission reduction credits for the current verification period will be registered only with VCS and not under any other GHG program. As per the validated PD, no other environmental credits are generated by the Project.

NSF confirmed there were no remaining issues from validations. No Project Description deviations were implemented for the Project during the reporting period. See section 3.2 above for previously validated methodology deviations.

Based on this review, NSF concluded the project was implemented as described in the Project Description and the Project Monitoring remained effective during the verification period.

## 4.2 Accuracy of GHG Emission Reduction and Removal Calculations

Emission reduction calculations for the reporting period were reviewed to ensure conformance in the formulas used and accuracy of the raw data used as inputs. The emission reduction calculation formulas were found to be conformant with Equation 2 described in AMS-I.C v 19 Methodology and the validated PD.

Baseline emissions were calculated as the consumption of coal fuel that would have been used in the absence of the project activity multiplied by the emission factor for the fossil fuel displaced. Coal consumption was determined as the net quantity of heat divided by the efficiency of the boiler that would have been used in the baseline scenario. The net energy is the result of the enthalpy gain reached in the boiler multiplied by the steam volume generated. The net quantity of steam/heat supplied by the Project ( $EG_{thermal, y}$ ) was determined by multiplying the difference between steam pressure enthalpy ( $h_{steam}$ ) and boiler feed water temperature enthalpy ( $h_{feedwater}$ ), the quantity of steam generated by the project activity ( $Q_{steam, y}$ ), which is conformant with the methodology deviation approved at validation, measured at the output of biomass Boiler No. 4. Enthalpy of steam and boiler feed water were determined according to steam and water thermodynamic properties tables.

Project emissions occurred from on-site fossil fuel consumption by equipment used to move biomass within the project facility and indirectly from electricity consumption attributed to the project activity. Emissions from electricity consumption (ECy) were calculated by multiplying Project electricity usage determined as described in the previous section by the appropriate eGRID emission factor in tCO<sub>2</sub>/MWh. The Project used the latest default US EPA eGRID emission factors for the SRTV sub-region for 2015, 2016 and 2017. Project emissions from fossil fuel consumption by the biomass loader (FC<sub>diesel, loader, y</sub>) was calculated by multiplying the fuel usage determined as described in the previous section by the diesel fuel emission factor in expressed in tCO<sub>2e</sub>/GJ.

Project leakage emissions from biomass processing, biomass transportation, and transportation of ash combustion residues are accounted for in accordance with AMS-I.C. Leakage emissions due to competing uses for the biomass that might have occurred in the absence of the project were evaluated at validation and excluded.

As described in the previous section, the emissions from off-site consumption of diesel fuel during the collecting and processing of biomass residues into a transport-ready fuel format were excluded for this monitoring period. The emissions from biomass transportation were determined as the emissions from off-site combustion of diesel fuel due to transporting of biomass residues from more than 200km to the project site (DAF<sub>biomass delivery</sub>). For delivery distances greater than 200 km, the emissions were calculated by multiplying the roundtrip distance by the appropriate fossil fuel emission factor and the fuel efficiency of a typical tractor, based on US DOT data, updated each monitoring period. Delivery distances were recorded on the biomass delivery tickets during receipt of biomass deliveries (Q<sub>biomass, j, y</sub>). Emissions from off-site combustion of diesel fuel due to transportation of ash (combustion residuals) from the Project to final disposal or beneficial use outlets are determined according to the roundtrip distance (DAF<sub>ash delivery</sub>) to the disposal site multiplied by the emission factor for diesel fuel and the fuel efficiency of a typical tractor, based on US DOT data, updated each monitoring period.

Finally, total emission reductions for the monitoring period are determined by subtracting the project and leakage emission from baseline emissions per Equation 2 of the Methodology.

NSF verified the project monitoring data for the following parameters and values:

| Data Unit/Parameter      | Description                                                                                               | Value Monitored as Verified                                                                                                |
|--------------------------|-----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| EG <sub>thermal,y</sub>  | The net quantity of steam/heat supplied by the project activity during the year y                         | For 2015: 543.80 TJ<br>For 2016: 483.26 TJ<br>For 2017: 515.65 TJ                                                          |
| EF <sub>grid, CM,y</sub> | Combined margin emission factor for the grid in year y                                                    | For 2015: 0.542 tCO <sub>2e</sub> /MWh<br>For 2016: 0.542 tCO <sub>2e</sub> /MWh<br>For 2017: 0.542 tCO <sub>2e</sub> /MWh |
| TDL <sub>y</sub>         | Average technical transmission and distribution losses for providing electricity to the project in year y | For 2015: 0.0449<br>For 2016: 0.0449<br>For 2017: 0.0449                                                                   |
| Q <sub>steam,y</sub>     | The quantity of steam generated by the project activity (Boiler #4) in year y                             | For 2015: 529,867,545 lbs                                                                                                  |

|                                 |                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------|--------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                 |                                                                                                  | For 2016: 468,393,722 lbs<br>For 2017: 498,692,219 lbs                                                                                                                                                                                                                                                                                                                        |
| $h_{\text{steam}}$              | The enthalpy of steam as it leaves the biomass boiler.                                           | For 2015: 1197.55 BTU/lb<br>For 2016: 1197.25 BTU/lb<br>For 2017: 1197.52 BTU/lb                                                                                                                                                                                                                                                                                              |
| $h_{\text{feedwater}}$          | The enthalpy of boiler feed water as it enters the biomass boiler (Boiler #4).                   | For 2015: 224.8 BTU/lb<br>For 2016: 219.3 BTU/lb<br>For 2017: 217.4 BTU/lb                                                                                                                                                                                                                                                                                                    |
| $FC_{\text{Diesel, loader, y}}$ | Quantity of diesel fuel used by the front-end loader and any other on-site fuel moving equipment | For 2015: 12,610 gal<br>For 2016: 11,120 gal<br>For 2017: 11,100 gal                                                                                                                                                                                                                                                                                                          |
| $EC_y$                          | Power consumed by the project activity                                                           | 1957 MWh each year                                                                                                                                                                                                                                                                                                                                                            |
| $DAF_{\text{biomass delivery}}$ | Estimated round-trip delivery distance                                                           | $[\Sigma(DAF)]$ Biomass:<br>For 2015: 70,533 km<br>For 2016: 76,987 km<br>For 2017: 71,916 km                                                                                                                                                                                                                                                                                 |
| $DAF_{\text{ash delivery}}$     | Estimated round-trip ash delivery distance                                                       | $[\Sigma(DAF)]$ Ash:<br>For 2015: 0 km<br>For 2016: 0 km<br>For 2017: 0 km                                                                                                                                                                                                                                                                                                    |
| $EFF_{tt,y}$                    | Fuel efficiency for tractor trailers                                                             | 9.50 (5.9 miles/gal) is the value for 2015 and 2016 and are the latest available values (published 2018)                                                                                                                                                                                                                                                                      |
| $Q_{\text{biomass,j,y}}$        | Quantity of biomass residues of type j delivered to the project activity, as received.           | 2015<br>All Biomass Delivered :<br>73,043 tons<br>Biomass Not Processed for<br>Project 73,043 tons<br>Biomass Processed for<br>Project 0 tons<br>2016<br>All Biomass Delivered :<br>60,790 tons<br>Biomass Not Processed for<br>Project 60,790 tons<br>Biomass Processed for<br>Project 0 tons<br>2017<br>All Biomass Delivered :<br>65,887 tons<br>Biomass Not Processed for |

|  |  |         |             |     |
|--|--|---------|-------------|-----|
|  |  | Project | 65,887 tons |     |
|  |  | Biomass | Processed   | for |
|  |  | Project | 0 tons      |     |

The verification process focused on the assessment of calculation spreadsheets to ensure that they were consistent with the formulas and equations described in the AMS-I.C methodology and the VCS Project Description. Copies of the raw data used in the calculations, including steam flow measurements, steam pressure, boiler feed water temperature, fuel and electricity purchase invoices, biomass, and ash delivery tickets were compared with the values used in the final calculations and tested for transcription or mathematical errors. The Audit Team performed an independent recalculation of the emission reductions from the verification period using a sample of the data above. The calculations for the entire period were reviewed as well to determine whether they were free of material misstatement. All calculation methods and emission factors used to determine emission reductions were consistent with those outlined in the validated VCS Project Description, Monitoring Report and AMS I.C. v 19 Methodology.

#### 4.3 Quality of Evidence to Determine GHG Emission Reductions and Removals

Recast Energy provided all requested documentation for emission reduction calculations including baseline emissions, project emissions and leakage emissions, as well as documentation of the Project data collection and summarization processes. NSF was provided the reporting period's Monitoring Report prepared in accordance with the latest VCS program template, 2015, 2016 & 2017 calendar year calculation spreadsheets, calibration records, and electronic data associated with steam generation, steam pressure, and steam temperature readings. NSF observed operation of the Project monitoring equipment while on site and obtained screen shots of the operating system as it was operating in real time. Measurements of required operational parameters for the Project's boiler were performed every ten seconds and retained by a Rockwell distributive control system (DCS). The project reduces raw to daily averages for steam produced, feed water enthalpy, net steam delivered, steam pressure & temperature and other factors in addition to boiler operating hours and performance. Raw data was reviewed from its source of generation to confirm the accuracy of the daily DCS information flow. The Project relied on the accuracy of the DCS to determine invoiced amounts of steam to the Project's customers. Customers have their own steam flow meters which the Project uses as a cross check on their delivered steam flow quantification and for relative checks on steam production used in emission reduction calculations. NSF reviewed and compared the daily raw data summaries to total report period steam production, and recalculated emission reductions. Project calculations and raw data matched.

The evidence provided was sufficient for verification of the Project and consistent with the requirements of AMS-I.C, VCS Standard, v3.7 (June 21, 2017, and the validated PD. NSF concluded the Project monitoring and supplemental data were appropriate and meets generally accepted evidentiary standards for best practice in GHG accounting to sufficiently quantify the GHG emission reductions.

#### 4.4 Non-Permanence Risk Analysis

Not Applicable - The Project generates emission reductions that are permanent and cannot be retrieved, since they are based on combustion of biomass, which once created cannot be undone. In addition, the Project is not an AFOLU activity.

### 5 SAFEGUARDS

#### 5.1 No Net Harm

Not Applicable - No net harm effects have been identified for the Project during the verification report period January 1, 2015 through December 31, 2017.

#### 5.2 Local Stakeholder Consultation

Not Applicable - No public input or additional hearings, comments or complaints have been conducted or received during the reporting period January 1, 2015 through December 31, 2017.

### 6 VERIFICATION CONCLUSION

On the basis of the work performed and review of the Project Monitoring Report, Validated Project Description and the necessary evidence requested during the verification process, NSF has concluded that the Recast Energy Louisville Fuel Switch From Coal to Biomass for Thermal Energy Project has been compiled in a transparent manner, the data was found to be accurate within reasonable assurance and the Project was implemented in accordance with the requirements of the VCS Standard v 3.7 dated June 21, 2017 and associated updates), the VCS Program Guide v 3.7 June 21, 2017 and the CDM AMS I.C. "Thermal energy production with or without electricity" v 19 June 17, 2011. The verification team confirms that all verification activities required by the criteria listed were performed as described in this report.

NSF Certification, LLC has verified emission reductions reported by the Recast Energy Louisville Fuel Switch From Coal to Biomass for Thermal Energy of 56,331 tonnes of CO<sub>2</sub>-e in calendar year 2015, 49,922 tonnes of CO<sub>2</sub>-e in calendar year 2016, and 53,362 tonnes of CO<sub>2</sub>-e in calendar year 2017.

Verification period: From 01 January 2015 to 31 December 2017

Verified GHG emission reductions and removals in the above verification period:

| Year | Baseline emissions or removals (tCO <sub>2</sub> e) | Project emissions or removals (tCO <sub>2</sub> e) | Leakage emissions (tCO <sub>2</sub> e) | Net GHG emission reductions or removals |
|------|-----------------------------------------------------|----------------------------------------------------|----------------------------------------|-----------------------------------------|
|      |                                                     |                                                    |                                        |                                         |

|              |                  |                |              | (tCO <sub>2</sub> e) |
|--------------|------------------|----------------|--------------|----------------------|
| 2015         | 57,642.9         | 1,236.4        | 75.4         | 56,331               |
| 2016         | 51,225.8         | 1,221.2        | 82.3         | 49,922               |
| 2017         | 54,659.4         | 1,221.0        | 76.9         | 53,362               |
| <b>Total</b> | <b>163,528.1</b> | <b>3,678.6</b> | <b>234.6</b> | <b>159,615</b>       |

\*Final values are rounded for simplicity

#### 6.1.1 Verification Summary:

|                                                    |                                                                                                                                                                                                                                                                                                        |
|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Project Proponent                                  | Recast Energy Louisville, LLC                                                                                                                                                                                                                                                                          |
| Project Location                                   | Louisville, Kentucky, USA                                                                                                                                                                                                                                                                              |
| Project Type                                       | Renewable Energy                                                                                                                                                                                                                                                                                       |
| Project Periods:                                   | January 1, 2015 - December 31, 2017                                                                                                                                                                                                                                                                    |
| Nature of Data Verified                            | Historical                                                                                                                                                                                                                                                                                             |
| Protocol/Methodology                               | <ul style="list-style-type: none"> <li>VCS Standard v 3.7 dated June 21, 2017</li> <li>VCS Program Guidelines v 3.7 June 21, 2017</li> <li>CDM AMS I.C. "Thermal energy production with or without electricity" v 19 June 17, 2011, and associated clarifications and methodological tools.</li> </ul> |
| Emission Reductions/Removals Verified              | Vintage 2015-2017: 159,615 metric tons of CO <sub>2</sub> -equivalent                                                                                                                                                                                                                                  |
| Verification Conclusion, with Reasonable Assurance | Based upon the verification activities described above, NSF has concluded that the vintage methane emission reductions in all material respects, fairly stated.                                                                                                                                        |
| Representation                                     | NSF represents that the Emission Reductions verified in this report have occurred in accordance with the applicable VCS Rules.                                                                                                                                                                         |
| Lead Verifier                                      | <br>Michael DeBusschere, October 11, 2018                                                                                                                                                                          |
| Internal Reviewer                                  |                                                                                                                                                                                                                    |

|  |                                |
|--|--------------------------------|
|  | Tina Sentner, October 11, 2018 |
|  |                                |

## APPENDIX A: FINDINGS

## NSF GHG CDM Renewable Energy (CDM I.C. Renewable Energy) Project Workbook: List of Findings

| Client:  |      | Recast Energy LLC                                                                                                                            | Job #: ↓                           | Reporting Year/Period: ↓                                                                                                                                 | FRS:                                                                                                                                                                                                                                              | C0173418            |
|----------|------|----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| Lead V.: |      | Mike DeBusschere                                                                                                                             | V1680824                           | 1/1/15 - 12/31/17                                                                                                                                        | Last Revision Date:                                                                                                                                                                                                                               | 10/7/2018           |
| #        | Type | Finding/Clarification                                                                                                                        | Ref.                               | Audit Evidence                                                                                                                                           | Responsible Party Action                                                                                                                                                                                                                          | Lead V/V Conclusion |
| 1        | CR   | Please provide the detailed spreadsheets for 2015 & 2016 enthalpy production                                                                 | Required to calculate assertion    | Not provided for original document review                                                                                                                | Assertion calculation spreadsheets were provided for each calendar year.                                                                                                                                                                          | Issue resolved      |
| 2        | CR   | Please clarify whether project meets additionality requirements of the VCS Standard                                                          | VCS Standard v 3.7, Section 3.14   | The Title V permit regulates GHG emissions as a condition of its issuance and a limit was placed in order that the project could avoid PSD requirements. | Non-issue. VCS Standard defers to the applicable CDM Method if there are specific additionality requirements in the Method. CDM AMS I.C. v 19 contains specific additionality tests which were met by the Project and verified during Validation. | Issue withdrawn.    |
| 3        | CR   | Please provide updated Monitoring Report(s)                                                                                                  | VCS Standard v 3.7, Section 3.18.3 | Only a draft Monitoring Report for 2017 was provided in Document Review                                                                                  | Project has provided an updated Monitoring Report for the assertion period 2015-2017.                                                                                                                                                             | Issue resolved      |
| 4        | CR   | Please provide DCS data summaries for three months of each report year                                                                       | VCS Standard v 3.7, Section 3.18.3 | No raw data was provided in document review                                                                                                              | Project has provided the requested DCS raw data.                                                                                                                                                                                                  | Issue resolved      |
| 5        | CR   | Please provide truck scale calibration documentation                                                                                         | VCS Standard v 3.7, Section 3.18.3 | No calibration of wood delivery scale used to measure inventory was provided                                                                             | Project has provided the requested calibrations.                                                                                                                                                                                                  | Issue resolved      |
| 6        | CR   | Please provide DCS Screer Shots of monthly summaries                                                                                         | VCS Standard v 3.7, Section 3.18.3 | Will provide corroborating raw data evidence for assertion calculations                                                                                  | Project has provided the requested DCS screen shots.                                                                                                                                                                                              | Issue resolved      |
| 7        | CR   | Please provide steam invoices and comparison steam receipts by Lubrizol and Zeon to corroborate thermal production for baseline calculations | VCS Standard v 3.7, Section 3.18.3 | Will provide corroborating raw data evidence for assertion calculations                                                                                  | Project has provided the requested steam invoicing and corresponding customer steam metering checks.                                                                                                                                              | Issue resolved      |
| 8        | CR   | Please provide a picture of Boiler #4's boiler plate                                                                                         | VCS Standard v 3.7, Section 3.18.3 | Used to establish existence of the project's equipment                                                                                                   | Project has provided the requested boiler plate picture.                                                                                                                                                                                          | Issue resolved      |

|    |    |                                                                                                                                                                 |                                    |                                                                                                                                                                                |                                                                                                                                                                   |                |
|----|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 9  | CR | Please provide documentation of the Project start date                                                                                                          | VCS Standard v 3.7, Section 3.7.1  | Required to reverify project PD                                                                                                                                                | Project has provided a statement by the air pollution permit authority within the Title V Operating Permit corroborating the start date.                          | Issue resolved |
| 10 | CR | Please provide attestation that Recast has not applied for emission reduction credits to any other certification body than VCS for the three-year report period | VCS Standard v 3.7, Section 3.11.7 | Required by VCS Standard to prevent double counting                                                                                                                            | Project has provided an updated Attestation as requested.                                                                                                         | Issue resolved |
| 11 | CR | Please provide documentation that Recast Energy is the sole owner of any emission reduction credits generated by the Project                                    | VCS Standard v 3.7, Section 3.18.2 | Required by VCS Standard to prevent double counting                                                                                                                            | Project has provided excerpts of customer contracts that stipulate Recast Energy is the sole owner of any emission reduction credits generated by the Project.    | Issue resolved |
| 12 | CR | Please reconcile the Monitoring Report emission reductions with the assertions.                                                                                 | VCS Standard v 3.7, Section 3.16.6 | Paragraph 1.1 of the Monitoring Plan disagrees with the emission reductions presented on Page 29 of the Report and the reduction calculation spreadsheets for all three years. | Monitoring Plan revised to show corrected assertion amounts for each year and consistent monitoring frequencies and data agglomeration periods per the Validation | Issue resolved |