METHODOLOGY ASSESSMENT REPORT

GREENHOUSE GAS CAPTURE AND UTILIZATION IN PLASTIC MATERIALS

Document Prepared By: Ruby Canyon Engineering, Inc.

Methodology Title	Greenhouse Gas Capture and Utilization in Plastic Materials	
Version	5	
Methodology Category	Methodology	X
	Methodology Revision	
	Module	
	Tool	
Sectoral Scope(s)	3. Energy Demand	

Report Title	Methodology Assessment Report for Greenhouse Gas Capture and Utilization in Plastic Materials
Report Version	1.0
Client	Newlight Technologies, Inc.
Pages	24
Date of Issue	November 15, 2018
Prepared By	Ruby Canyon Engineering, Inc.
Contact	743 Horizon Court, Suite 385, Grand Junction, CO, 81506

	Tel: +1-970-241-9298 Email: zeyler@rubycanyoneng.com www.rubycanyoneng.com
Approved By	Bonny Crews – Independent Technical Reviewer
Work Carried Out By	Zach Eyler – Lead Validator David LaGreca– Assessment Team Member Barbara Toole O'Neil – VCS Approved Standardized Methods Expert

Summary:

Ruby Canyon Engineering, Inc. (RCE) was retained by Newlight Technologies, Inc. (Newlight) to perform the methodology assessment of the *Greenhouse Gas Capture and Utilization in Plastic Materials* (Methodology). Newlight was assisted by Carbonomics, LLC (Carbonomics) in the development of the Methodology. This was the second assessment for the Methodology.

The purpose and scope of the methodology assessment was to evaluate whether the Methodology was prepared in accordance to VCS program requirements. RCE's assessment included a detailed review of the eligibility criteria, baseline scenarios and emissions, project boundaries and definitions, standardized methods applied, quantification calculations and data and parameters monitored.

The assessment was conducted in accordance with the VCS Methodology Approval Process, VCS Standard, VCS Program Guide and VCS Guidance for Standardized Methods.

RCE's assessment included a total of 18 findings. Newlight and Carbonomics provided satisfactory responses to all RCE's corrective action requests, requests for additional documentation and clarification requests.

RCE confirms that any uncertainties associated with the methodology assessment were addressed by Newlight and Carbonomics as part of the assessment process.

RCE confirms all methodology assessment activities, including objectives, scope and criteria, level of assurance, and the activity method and methodology revisions conform to the VCS Program Version 3.7 and VCS Standard Version 3.7. RCE concluded without any qualifications that the Methodology meets the requirements of the VCSA, and recommends that VCSA approve the Methodology.

Table of Contents

1 INTRODUCTION

1.1 Objective

The purpose of the methodology assessment was to evaluate whether the Greenhouse Gas Capture and Utilization in Plastic methodology was prepared in accordance to VCS program requirements. The findings of the assessment are described in this report.

1.2 Summary Description of the Methodology

The Methodology is for project activities that convert carbon dioxide (CO_2) and/or methane (CH_4), which would have otherwise been emitted into the atmosphere, into a useful plastic material for sale into the plastics market. Project activities reduce greenhouse gas (GHG) emissions through the sequestration of CO_2 and/or CH_4 into plastic material (if the plastic is non-biodegradable) as well as producing plastic material using a less emission-intensive process than traditional plastic manufacturing (both biodegradable and non-biodegradable plastic).

2 ASSESSMENT APPROACH

2.1 Method and Criteria

RCE conducted the assessment methods in accordance with the VCS Methodology Approval Process and standard GHG accounting and auditing procedures. RCE's assessment included a detailed review of the eligibility criteria, baseline scenarios and emissions, project boundaries and definitions, standardized methods applied, quantification calculations and data and parameters monitored. In addition, RCE assessed the documents' structure and clarity, including the clear definition of key terms.

RCE followed the following VCS criteria:

- VCS Standard v3.7, June 21, 2017
- VCS Program Guide v3.7, June 21, 2017
- VCS Guidance for Standardized Methods v3.3, October 8, 2013
- VCS Methodology Approval Process v3.7, June 21, 2017

2.2 Document Review

RCE conducted a detailed review of the Methodology to ensure that all Methodology components were in alignment with VCS criteria and requirements. In addition, RCE team members reviewed supporting documentation that was used to support Methodology components. RCE's lead assessor and team member focused on the following components of the Methodology: definitions, applicability conditions, project boundary, baseline emissions, quantification, monitoring and emissions factors utilized. RCE's VCS Standardized Methods Expert reviewed the activity method and positive list for adherence to VCS Guidance for Standardized Methods and Methodology Approval Process. RCE also assisted with the review of the activity method and positive list. All team members reviewed the documents for conformance to VCS Program Guide, the VCS Standard, VCS Guidance for Standardized Methods, and other guidance documents.

The final list of documents received and reviewed by the RCE assessment team is provided in Appendix A.

2.3 Interviews

RCE assessment team conducted interviews with the methodology proponent and their technical consultant throughout the assessment process. The interviews were used to discuss methodology assumptions, conservativeness, demonstration of additionality, VCS requirements, as well as to resolve corrective action requests, clarification requests, and other methodology issues. Several rounds of teleconferences were needed to resolve all outstanding issues. The following table identifies the team members and stakeholders involved in the interviews.

Dates	Attendees	Topics
5/7/2018	Zach Eyler, David LaGreca, Seth Baruch, Evan Creelman	Introductory Meeting – Group discussed the scope of methodology assessment and specific areas of focus.
8/30/2018	Zach Eyler, David LaGreca, Barbara Toole O'Neil, Seth Baruch, Scott Wollack	Discussion of List of Findings 1.0.
9/24/2018	Zach Eyler, David LaGreca, Seth Baruch, Scott Wollack, Mark Herrema	Discussion of List of Findings 2.0 and the possible addition of leather to the methodology.

2.4 Assessment Team

Zach Eyler – Assessment Team Member

Zach serves as a Vice President for Ruby Canyon, utilizing his broad experience with GHG programs and renewable energy to assist on a variety of work including GHG verifications, technical research and other client projects. In addition, he assists the company in understanding GHG regulations and policies across North America and internationally, using this knowledge to analyze potential new areas of growth. Specifically, Zach is helping lead Ruby Canyon's expansion into California's AB 32 cap-and-trade program as well as new Canadian province GHG programs in Quebec and Ontario. Zach also serves as Ruby Canyon's representative on a variety of GHG registry stakeholder groups that assist in the development of high level protocol and verification standards for new GHG programs. Zach has completed a wide range of verification work for projects across registries (PCT, CAR, TCR, ACR) including landfills, livestock, oil/gas, fuel switching, ODS, nitric acid production, and GHG entity inventories. Zach is currently an accredited Lead Verifier for the CAR, PCT and ACR programs. Zach is also an ARB accredited Lead Verifier and Project Specialist for livestock and ODS projects.

Prior to joining Ruby Canyon, Zach worked at Element Markets since 2008 where he managed over 15 carbon offset projects, and conducted all GHG policy and regulatory analysis to support the company's trading activities and client relationships in the U.S. and Canada. He also served as a company representative on carbon offset working groups including the Coalition for Emission Reduction Policy (CERP) and the Canadian Industry Provincial Offsets Group (IPOG). He holds a Bachelor's degree in Environmental Technology from NC State University and a Master's of Environmental Management from Duke University's Nicholas School of the Environment.

David LaGreca – Staff Environmental Scientist

David LaGreca began working at Ruby Canyon Engineering in June 2017. Since then, he has become increasingly engrossed in the political and scientific underpinnings of evolving greenhouse gas market places. David became certified under the Climate Action Reserve Landfill and General Protocols in 2017, having completed mandatory trainings as well as working on numerous CAR Landfill projects as verification team member. He has worked as verification team member on projects in the Ontario and British Columbia mandatory greenhouse gas reporting mechanisms, along with inventory verifications under The Climate Reserve. Additionally, he has thoroughly researched and reported on emerging markets under Mexico's evolving EMA standards, recently assisting with translation and project work for RCE's first four Oil and Gas Verifications under RENE. David provided support for greenhouse gas inventory consulting for domestic and international abandoned mine methane (AMM) and coal mine methane (CMM) projects through the US EPA. Along with GHG audits, he has developed corporate sustainability plans and conducted market analysis for environmentally-preferred purchasing standards for retailers. David has conducted feasibility analyses for adopting and advancing corporate performance within LEED and Energy Star building rating systems.

David graduated in 2015 from the University of Denver with a Master of Science in Environmental Policy and Management, emphasizing Energy and Sustainability. He wrote extensively on life cycle analysis in commercial product and building sciences, culminating with a thesis on deep energy retrofits in residential homes. In 2009, David obtained a Bachelor of Science degree from the University of Colorado at Boulder in Environmental Studies, where he presented his research into a comprehensive paradigm on new urbanism. Since graduation, David has focused on understanding environmental systems and the interconnectedness of human activities with ecological impacts. He spent time as a research intern with an environmental consulting company, and as sustainability lead/ project manager for a green building company in Grand Junction, CO.

Barbara Toole O'Neil – VCS Standardized Methods Expert

Since 2012, Ms. Toole O'Neil has focused on climate services, air quality, corporate responsibility and energy efficiency projects from the industrial manufacturing to ecosystems services sectors. Her work responsibilities have addressed a wide range of environmental issues from assessing methodologies, to preparing inventories or offset project documents to supporting the development of the ARB Mine Methane Capture Protocol as part of the working group, corporate social responsibility auditing, developing governance for sustainability non-profits, to writing the social standard (W+) to assess the impact of environmental projects (carbon, water, forestry, agriculture) on the quality of life for women in emerging third world countries. Ms. Toole O'Neil has been the lead assessor or part of the assessment team for multiple VCS methodologies.

Bonny Crews – Independent Technical Reviewer

Bonny Crews is a microbiologist with broad experience in soil, water, and environmental applications; she has a strong scientific and technical background with excellent communication skills. Bonny has a B.S. in Biology from St. Edward's University and an M.S. in Microbiology from Colorado State University where she studied the effects of oil shale retort on soil microorganism function. Bonny has a strong commitment to sustainable development. Specific interests in the greenhouse gas sector include landfill gas to energy projects, biogas production from agricultural wastes, composting and co-digestion of agro-industrial wastes, and alternative energy projects. Bonny is an accredited lead verifier for the livestock, organic waste digestion, and landfill sectors for the Climate Action Reserve (CAR). Additionally, Bonny is an accredited lead verifier for The Climate Registry (TCR), the American Carbon Registry (ACR) and the California Air Resources Board (ARB). Bonny is also an RCE-designated lead verifier and validator to the British Columbia (BC) Pacific Carbon Trust (PCT).

In various roles as Lead Verifier, Senior Reviewer, Team Member, and Project Lead at Ruby Canyon, Ms. Crews has participated in numerous projects that include GHG inventories, verifications, project and protocol validations, research, and consulting. Prior to joining Ruby Canyon, Bonny worked for seven years at Atlantic Richfield's research laboratory in Plano, TX. There she was a technical expert with the environmental support group, and served as the in-house expert on bioremediation and other biological environmental remediation methods. She has given presentations at national conferences, and written technical reports and journal articles. Bonny enjoys environmental problem-solving and working with multi-disciplinary teams.

2.5 Resolution of Findings

The methodology assessment included two rounds of evaluation by the assessment team, with the final assessment closing out all outstanding issues. Findings related to corrective action requests, requests for additional documentation and clarification requests were resolved during each round of evaluation. The RCE assessment team submitted an updated List of Findings to Newlight and Carbonomics during each round of assessment and Newlight and Carbonomics responded with corrective actions, edited documents, additional documents, as well as written responses for clarifications. The RCE assessment team and Newlight and Carbonomics discussed the List of Findings via teleconferences throughout the assessment process as noted above in section 2.3.

During the methodology assessment process, the RCE assessment team identified 18 items requiring a response including corrective action requests, additional documentation requests and clarification requests.

Several of the findings of the assessment involved adding clarification language and definitions to ensure that project proponents and verification bodies could properly utilize the Methodology. Similarly, clarifications were made to some of the quantification questions to ensure proper use and that the emissions reductions were conservative in nature.

The RCE assessment team requested additional support documentation to justify the proposed activity method applicability conditions and positive list. RCE requested additional information regarding the observed activity (OA) to demonstrate that the standardized method was appropriate. Newlight and Carbonomics provided sufficient documentation and evidence regarding the OA.

For a summary of all the findings and resolutions please see Appendix B.

3 ASSESSMENT FINDINGS

The RCE assessment team found the Methodology be in full compliance with the VCS Standard and other VCS requirements. RCE followed a methodological approach to the assessment, using applicable sections of the VCS documents outlined in section 2.1 as well as the VCS Validation and Verification Manual. Key elements of the methodology assessment included the following areas:

- Definitions
- Applicability Conditions
- Project Boundary
- Baseline Scenario
- Additionality
- Quantification of GHG Emissions Reductions and Removals
- Monitoring Data
- Activity Method analysis
- Emission Factors and their source documentation

3.1 Relationship to Approved or Pending Methodologies

The RCE assessment team reviewed similar methodologies to the Methodology and agrees with Newlight and Carbonomics that no methodologies could have reasonably been revised to meet the objectives of this new Methodology. No current methodologies exist regarding sequestration of GHGs into plastic materials. A list of the similar methodologies considered are noted below:

- VM0008 Weatherization of Single Family and Multi-Family Buildings
- VM0013 Calculating Emission Reductions from Jet Engine Washing
- VM0018 Energy Efficiency and Solid Waste Diversion Activities within a Sustainable Community
- VM0020 Transport Efficiency from Lightweight Pallets
- VM0025 Campus Clean Energy and Energy Efficiency
- AM0017 Steam system efficiency improvements by replacing steam traps and returning condensate
- AM0018 Baseline methodology for steam optimization systems
- AM0020 Baseline methodology for water pumping efficiency/improvements
- AM0027 Substitution of CO2 from fossil or mineral origin by CO2 from renewable sources in the production of inorganic compounds
- AM0046 Distribution of efficient light bulbs to households
- AM0060 Power saving through replacement by energy efficient chillers
- AM0070 Manufacturing of energy efficient domestic refrigerators
- AM0086 Distribution of zero energy water purification systems for safe drinking water
- AM0105 Energy efficiency in data centres through dynamic power management
- AM0113 Distribution of compact fluorescent lamps (CFL) and light-emitting diode (LED) lamps to households
- AMS-II.C. Demand-side energy efficiency activities for specific technologies
- AMS-II.G. Energy efficiency measures in thermal applications of non-renewable biomass
- AMS-II.J. Demand-side activities for efficient lighting technologies
- AMS-II.L. Demand-side activities for efficient outdoor and street lighting technologies
- AMS-II.M. Demand-side energy efficiency activities for installation of low-flow hot water savings devices
- AMS-II.N. Demand-side energy efficiency activities for installation of energy efficient lighting and/or controls in buildings
- AMS-II.O. Dissemination of energy efficient household appliances
- AMS-II.P. Energy efficient pump-set for agriculture use
- AMS-II.R. Energy efficiency space heating measures for residential buildings

- AMS-II.S. Energy efficiency in motor systems
- AMS-III.AV. Low greenhouse gas emitting water purification systems

3.2 Stakeholder Comments

No stakeholder comments were received during the public comment period.

3.3 Structure and Clarity of Methodology

The RCE assessment team concluded that the Methodology is clear, logical, concise and precise in manner. The RCE assessment team also concluded that:

- Newlight and Carbonomics correctly followed the instructions in the methodology template.
- The Methodology is consistent with the terminology used in the VCS Program and GHG accounting generally.
- Key words such as must, should and may have been used appropriately and consistently in the Methodology.
- The criteria and procedures were written in a manner that can be understood and applied readily and consistently by project proponents.
- The criteria and procedures were written in a manner that allows projects to be unambiguously audited against them.

Overall, the RCE assessment team concluded that the Methodology structure and clarity meet the VCS requirements.

3.4 Definitions

The RCE assessment team concluded that the Methodology has included all key terms, that they have been defined clearly and appropriately, and that they are consistently used in the Methodology. The RCE assessment team also confirmed that the definitions were listed in alphabetical order and were not already defined in other VCS documents.

3.5 Applicability Conditions

The RCE assessment team concluded that the applicability conditions are appropriate for the project activities targeted by the Methodology and are sufficiently clear for determining which project activities are eligible under the Methodology and which are not.

The applicability conditions represent a carefully targeted positive list. The applicability conditions are written in a sufficiently clear and precise manner. The RCE assessment team believes conformance with the applicability conditions can be demonstrated at the time of project validation.

The five applicability conditions in the Methodology and how they address environmental integrity and practical considerations are noted below:

1. Project activities must produce a useful plastic material, with an expected lifetime (period of non-degradation) of at least 100 years, through a carbon capture and utilization technology which converts CO_2 and/or CH_4 into a long-chain thermopolymer. Plastics that are biodegradable can be included in the project but can therefore only calculate baseline emissions related to the displacement of virgin plastic, not for the capture and sequestration of GHGs, which would be released to the atmosphere in the case of biodegradable materials.

   a. This condition ensures that projects will only take credit for sequestration if the plastic is not biodegradable.

2. Project activities must produce a plastic material that will be used to produce useful plastic products that are sold in the commercial market.

   a. This condition ensures that projects will not produce non-useful plastic just to generate carbon credits.

3. When CO_2 is used as a feedstock, the gas must come from a source that would have otherwise emitted the gas to the atmosphere (e.g.: the CO_2 is not processed/produced specifically for this project activity).

   a. This condition ensures that the feedstock for the plastics would have been emitted in the absence of project activities

4. When methane is used as feedstock, the project proponent must shall have a contract from the supplier of the CH_4 to help determine whether the gas is qualifying or non-qualifying, as defined in Section 3.

   a. This condition ensures that only gas that would not have already been destroyed is included.

5. Project activities must produce polyhydroxyalkanoates (PHA) directly from CO_2 or CH_4 through a process in which the resultant material displaces one of the following plastic materials:

   - Polypropylene (PP)
   - Polystyrene (PS)
   - Polyethylene (PE), including high-density and low-density polyethylene (HDPE, LDPE) as well as linear low-density polyethylene
   - Thermoplastic urethane (TPU)
   - Acrylonitrile butadiene styrene (ABS)
   - Polycarbonate (PC)
   - Polyethylene terephthalate (PET)
   - Polyvinyl Chloride (PVC)

   a. This condition ensures that only eligible plastic types are used and for which there are appropriate emission factors.

3.6 Project Boundary

The project boundary includes:

- The project facility where plastic materials are produced (note: more than one facility can be included in a project);
- The facilities from which the GHG feedstock is sourced (if not direct air capture); and
- The facilities where displaced conventional plastic material is manufactured.

The GHG sources, sinks and reservoirs (SSRs) included in the Methodology are:

Source		**Gas**	**Included?**	**Justification/Explanation**	**RCE Assessment Team Conclusion**
Baseline	Captured GHGs	CO_2	Optional	CO_2 is one of the main gases that can be captured by carbon capture and utilization technology. Note that some projects may use only CH_4 and not CO_2, in which case CO_2 may be excluded from the project boundary. Either CO_2 and/or CH_4 must be included within the project boundary.	The inclusion of CO_2 is appropriate when used by a project. Its exclusion is also appropriate when a project only uses CH_4.
		CH_4	Optional	CH_4 is one of the main gases that can be captured by carbon capture and utilization technology. Note that some projects may use only CO_2 and not CH_4, in which case CH_4 may be excluded from the project boundary. Either CO_2 and/or CH_4 must be included within the project boundary.	The inclusion of CH_4 is appropriate when used by a project. Its exclusion is also appropriate when a project only uses CO_2.
		N_2O	No	N_2O and any other GHGs are not gases that would be captured and utilized in plastic material with current technology.	The exclusion of N_2O is appropriate as the technology does not currently support its capture and use.
		Other	No	N/A	The exclusion is appropriate since only CO_2 and CH_4 can currently be used.
	GHGs from displacement of traditional plastics production	CO_2	Yes	The use and combustion of fossil fuels is the primary source of emissions from the traditional process of manufacturing plastics, including the refining of raw materials and process energy for production of plastics. See Appendix I for further detail. *Note: Transportation of plastic materials is not considered in either the baseline or project scenario because it is assumed that under either scenario,*	The inclusion of CO_2 is appropriate since it is the primary emission source for traditional plastic manufacturing.

Source		Gas	Included?	Justification/Explanation	RCE Assessment Team Conclusion
				conventional plastics or GHG-captured plastics would require transport.	
		CH_4	No	Excluded for simplicity	The exclusion is appropriate as this source is de minimis as compared to CO_2 for traditional plastic manufacturing.
		N_2O	No	Excluded for simplicity	The exclusion is appropriate as this source is de minimis as compared to CO_2 for traditional plastic manufacturing.
		Other	No	N/A	N/A
Project	GHGs from the project facility	CO_2	Yes	Use of electricity and combusted natural gas or liquid/solid fuels are the primary energy sources that would be used to power a facility capturing GHGs and manufacturing plastic material, and thus CO_2 would be the primary emission from that combustion.	The inclusion is appropriate as the primary source of Project emissions.
		CH_4	No	Excluded for simplicity	The exclusion is appropriate as this source is de minimis as compared to CO_2.
		N_2O	No	Excluded for simplicity	compared to CO_2.
		Other	No	Excluded for simplicity	The exclusion is appropriate.
	GHGs from burning of plastic material that previously captured	CO_2	Yes	Incineration of plastic material, re-releasing CO2 into the atmosphere	The inclusion is appropriate and conservative and is included in emission factors.
		CH_4	No	Excluded for simplicity	The exclusion is

Source		Gas	Included?	Justification/Explanation	RCE Assessment Team Conclusion
	CO_2 and CH_4				appropriate.
		N_2O	No	Excluded for simplicity	The exclusion is appropriate.
		Other	No	Excluded for simplicity	The exclusion is appropriate.
	Upstream emissions associated with processing waste GHGs	CO_2	No	Excluded because these emissions are so small relative to the upstream emissions of traditional plastic production	The exclusion is appropriate as these emissions are likely de minimis.
		CH_4	No	Excluded because these emissions are so small relative to the upstream emissions of traditional plastic production above	The exclusion is appropriate as these emissions are likely de minimis.
		N_2O	No	See above	The exclusion is appropriate as these emissions are likely de minimis.
		Other	No	See above	The exclusion is appropriate as these emissions are likely de minimis.

Overall, the RCE assessment team concluded that the project boundary is appropriate for the project activities in the Methodology. The included diagram clearly specified the project activities covered by the Methodology.

3.7 Baseline Scenario

The Methodology employs the project method for baseline crediting. The baseline scenario is the continuation of the manufacturing of plastic material through traditional processes (i.e., not through the use of GHG capture and utilization technology).

The RCE assessment team determined that the baseline was appropriate for the project activities covered by the Methodology and agrees with the criteria and procedures for determining the baseline scenario. Plastic production using traditional methods is the most plausible baseline scenario.

3.8 Additionality

The Methodology uses an activity method to determine additionality. First, projects must demonstrate regulatory surplus as required by the VCS Standard. Second, the Methodology employs a positive list, which is represented by the applicability conditions found in the Methodology. The positive list was established using the activity penetration Option A and the analysis is found in Appendix I of the Methodology. Newlight and Carbonomics provided sufficient evidence to demonstrate that the technology needed to utilize the Methodology is not available at the commercial scale and only one pilot facility currently exists in the world. The RCE assessment team agrees that the OA is equal to zero and concludes that the criteria and procedures to determine additionality are appropriate.

The applicability conditions are sufficient to ensure that projects meeting them are additional, while also ensuring that non-additional projects cannot use the methodology. This is primarily accomplished by the requirement to use a carbon capture and utilization technology in the production of plastic materials.

3.9 Quantification of GHG Emission Reductions and Removals

3.9.1 Baseline Emissions

Baseline emissions in the Methodology are comprised of two components.

The first component is the emissions associated with traditional plastics materials production processes. The equations and formulas used in the calculation of this component are appropriate and without error. The Methodology provides appropriate default emission factors (found in Appendix II of the Methodology) for the production of plastic using traditional methods. The emission factors are from reputable sources and were found to be reasonable and correctly applied for the project activities in the Methodology.

The second component is the emissions from the GHG feedstock which would remain in the atmosphere or be released to the atmosphere in the absence of the project. The equations and formulas used in the calculation of this component are appropriate and without error. The equations correctly account for any CH_4 used a feedstock that is non-qualifying and they also correctly account for CO_2 that is used a feedstock in the plastic. In addition, baseline emissions from this component are correctly excluded if the plastic produced is biodegradable and the Methodology has included a QA/QC check on the amount of CO_2/CH_4 to ensure conservativeness.

The RCE assessment team concludes that the procedures for calculating baseline emissions are appropriate for the project activities covered by the Methodology and that all GHG sources, sinks and reservoirs in the project boundary are covered.

3.9.2 Project Emissions

Project emissions in the Methodology are comprised of three components.

The first component is the emissions from the eventual incineration of plastic which would release CO_2 or CH_4 that was original sequestered by project activities. The Methodology provides default factors in Appendix II for the amount of plastic incinerated. The Methodology has default factors for the U.S. as well as a global default. These default factors for the U.S. are from reputable sources and the RCE assessment team found them to be reasonable and appropriate. The global default factor is conservative in nature and the RCE assessment team also found it to be reasonable.

The second component is the emissions from the use of electricity at the project production facility. These emissions are based on electricity used at the facility and electricity emission factors. The RCE assessment team found this quantification and the emission factors reasonable and appropriate.

The third component is the emissions from fossil fuel combustion at the project production facility. These emissions are based on any fossil fuels used at the facility and applicable emission factors for each fuel type. The RCE assessment team found this quantification and the emission factors reasonable and appropriate.

The RCE assessment team concludes that the procedures for calculating baseline emissions are appropriate for the project activities covered by the Methodology and that all GHG sources, sinks and reservoirs in the project boundary are covered.

3.9.3 Leakage

The Methodology identifies one potential source of leakage. A possible situation is where CH_4 from a landfill or other biological source is supplied as a feedstock for project activities and where this CH_4 was previously supplied to another facility. The previous facility would potentially have to switch to another fuel source that is more carbon intensive. To account for this possibility, the Methodology requires projects to:

- Demonstrate the CH_4 for the project is coming from an expansion of the CH_4 source where CH_4 was previously being vented; or
- Demonstrate there is excess gas supply potential that is not being utilized by the landfill or other CH_4 source; or
- Provide other evidence to the satisfaction of the verifier that the CH_4 source is supplying biogas which is not being diverted to another user.

The RCE assessment team concludes that the procedures in the Methodology to address leakage are sufficient and appropriate.

3.9.4 Net GHG Emission Reductions and Removals

Net GHG emissions reductions and removals are calculated by subtracting project emissions from baseline emissions. The RCE assessment team concludes that this calculation is appropriate for project activities.

3.10 Monitoring

The Methodology appropriately includes all necessary data, parameters and procedures for monitoring. In addition, the Methodology will allow project proponents to develop a monitoring plan to ensure that that GHG emission reductions and removals are monitored and reported appropriately. A summary table of all parameters and the RCE assessment team's conclusion is below.

Data and Parameters Available at Validation	
Parameter	**RCE Assessment Conclusion**
DF_{EL}	All information for this parameter is appropriate. Default factors provided in Appendix II with guidance on selecting the appropriate

	value.
EF_i	All information for this parameter is appropriate. Default factors provided in Appendix II with guidance on selecting the appropriate value.
Molecular weights of CO_2, CH_4 and plastic material	All information for this parameter is appropriate. Values are from the periodic table.
RCM_{C02} and RCM_{CH4}	All information for this parameter is appropriate. Values provided are based on molecular weights.
GWP of CH_4	All information for this parameter is appropriate. GWP is sourced from IPCC 4^{th} Assessment Report.
$FC_{,y}$	All information for this parameter is appropriate. Values are sourced from IPCC 2006 guidelines.
$EF_{a,y}$	All information for this parameter is appropriate. Values are sourced from IPCC 2006 guidelines.

Data and Parameters Monitored	
Parameter	**RCE Assessment Conclusion**
$Q_{gross,i,y}$ and $Q_{add,i,y}$	All information for this parameter is appropriate. Methodology provides adequate guidance on using scales to correctly measure plastic and any additives sold by the project. The measurements procedures and QA/QC procedures are sufficient to ensure accurate weight data.
$Q_{CO2,meter,y}$ and $Q_{CH4,meter,y}$	All information for this parameter is appropriate. Methodology provides adequate guidance on using flow meters to correctly measure the amount of CO_2 or CH_4 captured by the project. The measurements procedures and QA/QC procedures are sufficient to ensure accurate flow data.
$QF_{Per,y}$	All information for this parameter is appropriate. Methodology provides adequate guidance on determining the appropriate percentage of feedstock CH_4 that is qualifying. The measurement procedures and QA/QC procedures are sufficient to ensure an accurate estimate for the qualifying CH_4 percentage.
$Q_{elec,y}$	All information for this parameter is appropriate. Methodology provides adequate guidance on determining the amount of electricity consumed by the project facility. The measurement methods or

	source data for this parameter are described appropriately as well as potential QA/QC procedures, if applicable.
EF_{elec}	All information for this parameter is appropriate. Methodology provides adequate guidance on determining the appropriate emissions intensity for electricity used by the project. The measurements procedures and QA/QC procedures are sufficient to ensure accurate data.
$Q_{ff,y}$	All information for this parameter is appropriate. Methodology provides adequate guidance on determining the amount of fossil fuels consumed by the project facility. The measurement methods or source data for this parameter are described appropriately as well as potential QA/QC procedures, if applicable.

4 ASSESSMENT CONCLUSION

The RCE assessment team concludes, without limitation, that the Methodology titled "Greenhouse Gas Capture and Utilization in Plastic Materials," version 5, October 31, 2018, complies with all assessment criteria.

5 REPORT RECONCILIATION

Not applicable.

6 EVIDENCE OF FULFILMENT OF VVB ELIGIBILITY REQUIREMENTS

RCE met the eligibility requirements set out in the VCS Methodology Approval Process and VCS Standard based on its experience and accreditation in VCS Sectoral Scope 3 – Energy demand and ANSI Sectoral Scope 1. In addition, RCE included a standardized methods expert as part of the assessment team, meeting VCS requirements.

7 SIGNATURE

Signed for and on behalf of:

Name of entity: _*Ruby Canyon Engineering, Inc.*_______

Signature: ___ ______

Name of signatory: _*Zach Eyler*_ ______________________

Date: __*11/15/2018*________________________

APPENDIX A – DOCUMENTS REVIEWED

1. "A Whopping 91% of Plastic Isn't Recycled". By Laura Parker and Published by National Geographic, July 19, 2017.
2. CDM Methodology AMS III B.A.: Recovery and recycling of materials from E-Waste, UNFCCC.
3. Global Plastic Production Rises, Recycling Lags. By Gaelle Gourmelon and Published by Vital Signs, January 27, 2015.
4. "How Long Does it Take a Plastic Bottle to Biodegrade", Published by Postconsumers, October 31, 2011.
5. "How Quickly Does Plastic Breakdown" by Kenneth Sleight, February 21, 2011.
6. "Plastic Recycling Facts and Figures". By Rick LeBlanc and published by The Balance, June 1, 2017.
7. US Environmental Protection Agency: Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM), Containers, Packaging and Non-Durable Goods Materials Chapter, February 2016.
8. Winnipeg Sewage Treatment Program South End Plant, Process Selection Report, Appendix 7. July 2011.

APPENDIX B – SUMMARY OF FINDINGS

Finding	Description	Project Proponent Response & Action	RCE Conclusions
CAR1	Methodology language/formatting: -Methane/CH4 and carbon dioxide/CO2 are used interchangeably throughout. Consider standardizing. -Variety of edits noted in tracked changes in the methodology. -Ensure that all chemical compounds have proper subscript formatting -Ensure consistent use of tonne, metric ton and MT.	Changes made (keep in mind that VCS prefers the use of short tons and metric tonnes)	All changes and edits accepted.
CAR2	Consider including the following definitions in section 3 of the methodology. 1) Thermopolymer 2) Biodegradable 3) Virgin plastic 4) Feedstock 5) Additives 6) MFR and DMM are defined on page 26; should be added to definitions sections	Changes made	All definitions accepted.
CAR3	Appendix I: Activity Method does not clearly outline and discuss alternative baseline scenarios.	We believe the only baseline scenarios would be (1) continued manufacturing of traditional plastic material with no plastic production involving GHG sequestration or perhaps (2) large-scale adoption of this technology many years into the future, at which point if the 5% threshold is exceeded, it would no longer be eligible for carbon credits. This language inserted into the protocol document in Annex I.	All additions accepted.
CAR4	While Equation 8 is the check, it is not clear that the lower of MFR and DMM should be used for baseline emissions. Methodology notes that "If the meter measurements are less, this situation should be explained or corrected to the satisfaction of the verifier."	The DMM should always be greater than the MFR because the assumption is that no process is 100% efficient and if CO2 or CH4 leaks out, it would mean DMM would be higher than MFR, which would reflect what is really locked in the plastic. Thus, we believe the MFR should be used and would therefore be conservative because it should always be	This change is accepted.

	How would one correct this situation other than taking the lower value? Consider adding or revising Equation 8 to take the lower value.	lower. The DMM method is intended as a check or validation since it is hard to confirm the chemical formula of a compound just by looking at it. See change in equation 8 -- if the DMM is lower and no explanation can be provided, then the project proponent must use the lower value to be conservative.	
CAR5	If biodegradable plastics are eligible for this methodology, please include an explicit requirement that no baseline emissions can be claimed for GHG feedstock (Equation 4 = 0).	Change made under Eq. 4.	This change is accepted.
ADR1	Please provide additional documentation or research to support only one company existing currently and no other known projects. Also, see CL 11.	See information below table.	Additional information provided accepted.
ADR2	Please provide the location in the City of Winnipeg report for the emission factors TPU, ABS, PC. We cannot locate the values in the report.	See: https://www.winnipeg.ca/finance/findata/matmgt/documents/2012/682-2012/682-2012_Appendix_H-WSTP_South_End_Plant_Process_Selection_Report/Appendix%207.pdf	Source documentation provided and EF values confirmed.
CL1	Project activities must produce PHA (requirement #4), but based on quick research, PHAs are classified as biodegradable. #1 of the applicability conditions allows biodegradable plastics, but are only credited for the displacement of virgin plastic. Is this the intent? Please clarify.	PHA is a biodegradable, enzymatic (by microorganisms), as opposed to hydrolytically (by water) and can be mixed with additives, such as antimicrobial agents, to prevent biodegradation for given applications, such as furniture or automotive parts. In these cases, baseline emissions can be counted for the capture of GHGs, because that can be considered permanent.	Explanation accepted.
CL2	Project boundary: Is it expected that a project will only use one facility for plastics production? If possible to use multiple facilities as part of project, consider updating section 5.	It is anticipated there will eventually be multiple facilities, but we were thinking each different facility would be a different project/PDD, etc. That said, we changed the first bullet in Section 5 to allow multiple facilities to be included in one project -- in order to provide flexibility.	Added language accepted.
CL3	Project boundary: The project boundary includes upstream emissions from the extraction of raw	Based on research and discussions with Newlight, we don't believe the emissions associated with the production of any raw	Explanation

	materials. This upstream component is part of the emission factors noted in Appendix II that are part of the WARM model. The inclusion of upstream emissions as part of the project boundary is uncommon in methodologies due to large uncertainties in emissions since those operations are not under the control of the project proponent. Please justify this inclusion and whether the methodology takes into account any uncertainties in the default emission factors in Appendix II. Are there any upstream project emissions that should be included? If applicable, please revise the spatial boundary diagram to include this SSR. If applicable, please also include this SSR in Table 2, and the justification for why they have been excluded.	materials/feedstocks (including the GHGs) to be anywhere close to the emissions associated with conventional plastic production -- particularly considering the petroleum processing required to make plastic. By just about any standard in carbon accounting, these emissions would be de minimis compared to what it is displacing. Plastic production is over 1 ton CO2eq./tPlastic and the upstream emissions of Newlight's raw materials is mostly related to transportation of those materials and is a fraction of that.	accepted. Changes to the SSR diagram and SSR Table 2 accepted.
CL4	In Appendix I, the methodology notes that the pilot facility has only produced plastics from "shipped CO2 from another source". Please clarify the source of the CO2 for these plastics and if any consideration was given to whether any CO2 sources should be considered non-qualifying (like CH4).	It is envisioned that the CO2 would come from waste facilities, which would have otherwise emitted the CO2 to the atmosphere. Applicability Condition added.	Added language accepted.
CL5	In Baseline Emissions, component 2 and Appendix II: Please clarify whether the 100% virgin or the current mix emission factor should be used for raw material acquisition and manufacturing. Stated as virgin on page 11, but current mix on page 32. If using virgin, what is the justification vs. current mix?	Change made in Component 2 section (see p. 11 and 12).	Clarified language accepted.

CL6	No uncertainties in quantification of net GHG Reductions and Removals are mentioned, are there any circumstances in which totals can be distorted or otherwise unclear (e.g. new plastic types, new technologies, etc.)?	We do not believe so.	Newlight and Carbonomics explained that the monitoring procedures for GHGs sequestered are clear and provide for accurate calculations with little uncertainty. Explanation accepted.
CL7	Production of plastic material: Are their certain weighing techniques that are acceptable and should be used? Any methods that should not be allowed?	Any weighing mechanism where the weights can be recorded and verified through a record of periodic calibration is sufficient.	Explanation accepted.
CL8	Barbara Toole O'Neil (BTO): "Methodologies shall use a standardized method (i.e., performance method or activity method) or a project method to determine additionality and/or the crediting baseline, and shall state which type of method is used for each" The methodology does not state which standardized method of the project method is to be used for the crediting baseline. P. 10 of the draft methodology	Project method is used (see Section 2). Sentence also added on p.10.	Additional language accepted.
CL9	Barbara Toole O'Neil (BTO): …."Following their initial approval, methodologies are subject to periodic re-assessment, as set out in VCS document Methodology Approval Process". It wasn't clearly stated when the positive list will be updated.	Sentence added on p. 34 instructing project proponents to use the latest version of the WARM model.	Additional language accepted.
CL10	Barbara Toole O'Neil (BTO): "Procedure for New Technologies.. This addresses the situation of a new	Sentence added on p. 31 that says the materials have been available for more than three years, thus not requiring a demonstration of barriers	Additional language

	technology being introduced into the market that can be expected to be successful without carbon finance. The project activity is deemed to be commercially available when the entirety of the technological solution is available on a commercial basis. Individual technological components may be available in the marketplace before this time, but this does not constitute the commercial availability of the project activity. To address this potential free-rider situation, it is necessary to demonstrate that new project activities face barriers. " The Appendix could more clearly describe the status of the technology. For instance pilot scale could be 10 gm/hr, 10 kg/hr or 1000kg/hr. A small pilot is less likely to be ready for commercial scale in the near future.	according to VCS guidelines.	accepted.
CL11	Barbara Toole O'Neil (BTO): "Methodologies shall include sufficient information and evidence to allow the reader to reach the same assessment conclusion on the appropriateness and rigor of the standardized method reached by the two validation/verification bodies in the methodology approval process, noting that the confidentiality of proprietary data may be protected as set out in Section 4.5.6(5). " The explanation in the Appendix did not provide sufficient information to allow a reader using the methodology to reach a conclusion on the appropriateness and rigor of the standardized method.	See information below table.	Additional information provided accepted.

<u>Response to ADR 1 and CL 11: Further evidence of lack of OA (observed activity)</u>

List of Awards for Newlight: Newlight Technologies has received a number of innovation awards related to its technology.

1. In 2016, Newlight received the Presidential Green Chemistry Challenge Award
2. Also in 2016, Newlight received Bloomberg New Energy Pioneer Award
3. In 2014, Newlight won the PC Magazine Technical Excellence Awards
4. In 2013, Newlight won the R&D 100 Award, being recognized as “one of the 100 most technologically significant innovations of the year”
5. Newlight’s main product, AirCarbon was named “Biomaterial of the Year” in April 2013, and Newlight was named “Most Innovative Company of the Year” by the American Business Awards in June 2013.

Patent Searches: A thorough Google search on similar patents revealed no similar patents to what Newlight is doing, and similar Google searches, using keywords like “GHG-containing” plastics and similar variations yields no significant businesses have a commercial-scale business. There are other companies that are experimenting with using CO2 to produce polymers and foams – often with the support of the US Department of Energy and other government agencies -- but as of the writing of this methodology, nothing has reached any substantial commercial scale (See: https://energy.gov/fe/articles/recycling-carbon-dioxide-make-plastics).

In addition, Newlight is a finalist in the Carbon XPrize:

A new industry is slowly developing, which focuses on carbon capture and utilization (CCU). A step beyond carbon capture and sequestration (CCS), the goal of CCU is to convert waste CO2 into a useful product or use it as a feedstock for other products. CCU technology – whether it’s locking captured CO2 into solid materials or liquid fuels – is still in its infancy, as illustrated by the Carbon XPrize, a competition similar to the Ansari XPrize (incenting reusable spacecraft technology) and designed to incentivize the CCU industry. Just the existence of the Carbon XPrize illustrates the lack of any mature CCU sector. A number of start-up companies are working on sequestering CO2 into plastics, concrete, carbon nanotubes and other solids. Newlight is the only finalist in the XPrize competition that is focused solely on producing plastic material.