# Priority Climate Action Plan for Habematolel Pomo of Upper Lake

**EPA Grant Number: 98T79501**

**February 29, 2024**


**Prepared by:**

Habematolel of Upper Lake
9470 Main Street
(P.O. Box 516)
Upper Lake, CA 95485


**Prepared for:**

US EPA Region 9
75 Hawthorne Street
San Francisco, CA 94105

**Executive Summary**

Habematolel Pomo of Upper Lake, a federally recognized Indian tribe (the "Tribe"), was awarded a Climate Pollution Reduction Grant from EPA and has developed this Priority Climate Action Plan (PCAP) as the first major grant contract deliverable. The PCAP is based on both current and planned Tribal operations. Current operations generally consist of the operation of Running Creek Casino and maintenance of assets on Tribal property, including undeveloped property, homes, buildings, roadways, drinking water systems, and septic tanks. Planned future operations include the procurement of land for the construction of multiple biofuel production facilities, construction of the biofuel production facilities, and operation of the biofuel production facilities. In summary, the PCAP outlines the following actions:

1. Reduce electricity consumption by 10% on existing Tribal property.
2. Reduce fossil fuel for building use by 10% on existing Tribal property.
3. Reduce fossil fuel consumption for transportation by 10% for existing Tribal vehicle fleet.
4. Reduce solid waste generation by 10% on existing Tribal property.
5. Complete the Workplan for the biofuel production facilities.
6. Select and purchase the properties for the biofuel production facilities (locations to be defined by the Workplan).
7. Construct and operate the Renewable Fuel Oil ("RFO") production facilities.

Importantly, the Tribe is poised to rapidly develop the biofuel production facilities. The Tribe, through its wholly owned entity HPUL Green Energy, LLC, is working with its development partners in actively developing a biomass to biofuels project in Western Washington that would contribute towards addressing the impacts of climate change by reducing greenhouse gas (GHG) emissions. This plant will be in addition to a plant that is currently being planned near Millinocket, Maine. Our Pomo culture, similar to that of other tribes, has always stressed the importance of proper stewardship of our lands and natural resources. The Tribe's philosophy is that we are responsible for our actions and how those actions impact the next seven generations of our Tribe. The Tribe's dedicated EPA department has long advocated for the importance of protecting the environment and natural resources to the benefit of generations to come long after us. It is for this reason the Tribe wishes to study the potential positive impacts of multiple planned biofuels projects on the potential reduction of greenhouse gas emissions.

Based on work to date, the Tribe expects that the necessary ingredients are present for successful projects which would convert unwanted (and dangerous) forest residues into biofuel using a proprietary commercial rapid pyrolysis process (the RTP® Technology or RTP). The biofuel may be used as a heating oil replacement in commercial boilers or as a feedstock at refineries.

In addition to the immediate investment and commercial goals of the Tribe, one of our most important goals is to re-acquire land that we have lost, and to use and develop that land in a sustainable fashion in keeping with our proud history. At a minimum, this could include using a parcel of land dedicated to developing an RTP unit for the biofuels production for internal use and external sales. Available timber and associated commercial slash could be harvested on a sustainable basis, with trees replanted according to a schedule to ensure continued carbon absorption, and the slash would be used as feedstock. We will also pursue additional carbon sink opportunities, including applications in ag tech and regenerative farming, and invest directly in reducing existing GHG emissions from fossil fuel use and solid waste disposal.

The Tribe operates under a formal constitution which establishes the elected Executive Council as the Governing Body for the Tribe. The Executive Council has the full authority to implement all of the priority GHG reduction measures outlined in this PCAP.

**Abbreviations & Definitions**

| | |
|---|---|
| BIA | Bureau of Indian Affairs |
| CAA | Clean Air Act |
| CFR | Code of Federal Regulations |
| CCAP | Comprehensive Climate Action Plan |
| CGE | CastleRock Green Energy, LLC |
| CO | Carbon Monoxide |
| $CO_2e$ | Carbon Dioxide Equivalents |
| CPACE | Commercial Property Assessed Clean Energy |
| CPRG | Climate Pollution Reduction Grant |
| Ensyn | Ensyn Corporation |
| EPA | U.S. Environmental Protection Agency |
| GHG | Greenhouse Gas |
| GHGRP | Greenhouse Gas Reporting Program (40 CFR Part 98) |
| HAP | Hazardous Air Pollutants |
| HPUL | Habematolel Pomo of Upper Lake (Grantee Organization) |
| ICR | Information Collection Request |
| JTW | John T. Williams Law |
| NOX | Nitrogen Oxides |
| OAR | EPA Office of Air and Radiation |
| PCAP | Priority Climate Action Plan |
| PM | Particulate Matter |
| PM2.5 | Particulate Matter with a diameter of less than 2.5 microns |
| PM10 | Particulate Matter with a diameter of less than 10 microns |
| PO | EPA Project Officer for Grant |
| POP | Period of Performance |
| POR | EPA Project Officer's Representative |
| POTW | Publicly Owned Treatment Works |
| PWP | Project Work Plan |
| QA | Quality Assurance |
| QAM | Quality Assurance Manager |
| QAMD | Quality Assurance Manager Delegate |
| QAPP | Quality Assurance Project Plan |
| QC | Quality Control |
| RFO | Renewable Fuel Oil |
| RFS | Renewable Fuel Standard |
| RTP | Rapid Thermal Processing |
| SAF | Sustainable Aviation Fuel |
| SOX | Sulfur Oxides |
| TGIT | Tribal - GHG Inventory Tool |
| TL | Task Leader |
| TOC | Total Organic Carbon |
| TPY | Tons per Year |
| TRC | TRC Environmental Corporation |

# Table of Contents



**List of Tables**



**List of Figures**



**List of Appendices**

# 1. Introduction

Habematolel Pomo of Upper Lake, a federally recognized Indian tribe (the "Tribe" or HPUL), descend from four pre-contact tribes known as the Xowalek, Danoxa, Yobotui and Kaiyao-Matuku. These four tribes occupied the region of Upper Lake, California since time immemorial. After being displaced from its ancestral lands, the Tribe succeeded in having the federal government set aside the Upper Lake Rancheria for the Tribe in 1907. This reservation ultimately grew to 564 acres through a series of intermittent acquisitions. Unfortunately, during the McCarthy-era termination of many tribes, Congress began the process of terminating the Tribe in 1958. Fortunately, Congress repudiated the termination policy during the civil rights era of the 1960s and the termination process was never completed. In 1975, the Tribe sued to restore its federal recognition and won its lawsuit in 1983 with the court ruling that the Tribe had never been terminated. Unfortunately, the attempted termination left the Tribe landless and the BIA insisting on a new election to approve a new constitution.

The Tribe successfully approved its modern Constitution in 2004, officially adopting its traditional name, the Habematolel Pomo of Upper Lake (rather than Upper Lake Rancheria). The Tribe then undertook action to restore a small portion of its original land base. After an arduous federal regulatory process, the Department of the Interior placed 11.24 acres of land into trust for the Tribe on September 8, 2008. The Tribe has just recently placed another 10 acres into trust.

The Tribe is committed to restoring its Tribal lands and sustainably developing and managing all property and other assets owned by the Tribe. Accordingly, the Tribe recognizes the importance of developing and managing property, assets, and operations with climate pollution prevention and reduction at the forefront of governance.

Consistent with this vision for sustainable operations, the Tribe, through its wholly owned entity HPUL Green Energy, LLC, has secured access to proprietary and patented technology (i.e., Rapid Thermal Processing or RTP Technology from Ensyn Corporation) which converts residual non-food biomass from the forest and agricultural sectors to high yields of light liquid biofuels referred to a Renewable Fuel Oil® (RFO). The Tribe plans to acquire additional property where it will develop RTP Technology, effectively extending the impact of its operation well beyond current boundaries.

## 1.1. Climate Pollution Reduction Grant Program

The United States Environmental Protection Agency's (EPA) Climate Pollution Reduction Grant Program provides an excellent opportunity for the Tribe to fulfill its vision for sustainable development and operation of Tribal property and assets with eventual deployment of biofuel production facilities using RTP Technology, strategically placed to convert non-commercial wood waste (often a fire danger) into carbon neutral liquid fuel. The Tribe applied for and was awarded a Climate Pollution Reduction Grant that provided funding for the development of a comprehensive Workplan for GHG reduction planning and to study the potential positive impacts that biofuel production could have in furthering the Tribe's climate protection goals. A copy of the Tribe's grant application is provided in Appendix A.

The study Workplan will determine the preliminary feasibility of locating biofuel production using the technology secured by the Tribe at locations in close proximity to large industrial timber operations or where forest management needs slash disposal. Timber operations would supply the needed non-commercial wood waste feedstock ("slash"). "Slash" in this context is defined as "any material left on

the ground after trees have been cut. Slash is usually the limbs and the tops of trees."[1] The Tribe has prioritized this program because it has witnessed the destruction from forest fires firsthand several times, even having to completely evacuate the reservation area in 2018. Such residues qualify as "Renewable Biomass" under the EPA's Renewable Fuel Standard (RFS) program. Use of this feedstock would decrease the occurrence of devastating forest fires, while reducing GHG emissions by approximately 85% relative to fossil fuels. The Workplan will include:

- Evaluation of the most promising site or sites based on a number of key factors.
- Studying the potential impacts of reducing GHG emissions by converting slash, a potential GHG emission source, into a carbon neutral fuel while also reducing the likelihood and impacts of future forest fires.
- Outlining a permitting strategy.
- Identifying and analyzing infrastructure alternatives to economically access both heating oil and refinery customers.
- Conducting a market survey for the biofuel.
- Conducting a feedstock survey to achieve the goal of understanding the dynamics of assisting in future forest management and providing a carbon neutral biomass disposal option.
- Determining any social/political factors to be addressed to ensure project acceptance and success.

There are four key deliverables that the Tribe must furnish to satisfy the conditions of the grant award:

1. A Quality Assurance Project Plan (QAPP). The QAPP has been submitted and was approved by EPA on October 17, 2023. The QAPP is provided in Appendix B.
2. A Greenhouse Gas (GHG) Inventory. The GHG Inventory has been completed in accordance with the QAPP using EPA's Tribal Greenhouse Gas Reporting Tool (TGIT) Community Module. The GHG Inventory results are based on current Tribal operations and are contained in this Priority Climate Action Plan (PCAP).
3. This document, the Priority Climate Action Plan.
4. A Comprehensive Climate Action Plan (CCAP), which will be determined largely by the Workplan described above.

## 1.2. PCAP Overview

This PCAP is based on both current and planned Tribal operations. Current operations generally consist of the operation of Running Creek Casino and maintenance of assets on Tribal property including undeveloped property, homes, buildings, roadways, drinking water systems, and septic tanks. Planned future operations include the procurement of land for the construction of biofuel

[1] https://climate-woodlands.extension.org/what-is-logging-slash/

production facilities, construction of biofuel production facilities, and operation of biofuel production facilities.

The Tribe operates under a formal constitution which establishes the elected Executive Council as the Governing Body for the Tribe. The constitution grants the Executive Council the full authority to implement all of the priority GHG reduction measures outlined in this PCAP.

### 1.2.1. Current Tribal Operations

The GHG Inventory contained in this PCAP was developed using EPA's TGIT. The Tribe obtained records for vehicle use, electricity consumption, fossil fuel consumption, solid waste disposal, and septic tank installations. Available data were formatted to align with TGI input requirements. On this basis, total GHG emissions for the Tribe in calendar year (CY) 2023 were 171.54 metric tons (MT) of carbon dioxide equivalents ($CO_2e$).

Approximately 65% of the Tribe's current GHG emissions are associated with fossil fuel and electricity consumption. Accordingly, the Tribe will prioritize measures to reduce fossil fuel and electricity consumption by 10%, resulting in an 11 metric ton annual reduction in GHG emissions. Priority measures will include energy efficiency improvements at the casino and improved management of the Tribe's vehicle fleet.

Approximately 17% of the Tribe's GHG emissions are associated with solid waste disposal. The Tribe will prioritize measures to reduce solid waste generation by 10% resulting, in a 3 metric ton annual reduction in GHG emissions. Priority measures will focus on reducing solid waste associated with the casino operation. Measures under consideration include improving recycling and separating food waste for commercial scale composting.

The planned priority GHG reduction measures for current Tribal operations will reduce operating costs for the Tribe, reduce GHG emissions from Tribal operations, reduce emissions of a number of co-pollutants associated with fossil fuel consumption and mixed-grid electricity generation.

### 1.2.2. Planned Tribal Operations

To support longer term and more significant GHG reductions, the Tribe will continue to advance the Workplan for the construction and operation of RFO production facilities, both on Tribal lands and on other private land. The aggregate production capacity, which is initially targeted at 80 million gallons per year, will not only result in GHG emissions reductions that will completely offset all of the Tribe's current GHG emissions, but will have a much larger impact on the overall GHG emissions footprint nationwide. Further, given the transformative capabilities of the RTP technology in co-processing, cellulosic ethanol production, and ultimately sustainable aviation fuel (SAF), the Tribe has the opportunity to create material benefit in national goals that extend well beyond this initial plan. When compared to oil and natural gas, RFO product shows a significant reduction in life cycle greenhouse gases. Because only feedstock that meets the EPA's RFS program's definition of Renewable Biomass is used to manufacture the RFO product, the RFO product can be considered a carbon neutral fuel for purposes of GHG or fossil fuel abatement programs. Based upon analysis using the GHGenius model from (S&T)$^2$ Consultants Inc., for every 100,000 MMBtu of natural gas that is displaced by RFO product, a GHG reduction of approximately 5,222 $MTCO_2e$ is realized, if used for boiler fuel. To put this in context for our planned capacity of

biofuels production, for every 80 million gallons of RFO used to displace natural gas, there will be a net reduction of ~360,000 metric tons of $CO_2$ per year. For every 80 million gallons of RFO used to displace traditional heating oil, there will be a net reduction of 480,000 metric tons of $CO_2$ per year. On the low end (assuming all natural gas displacement), this represents a reduction of more than 2,000 times the Tribe's current GHG emissions. The GHGenius modeling report is provided in Appendix C.

Priority greenhouse gas reduction measures associated with the longer-term vision for constructing and operating the RFO production facility include:

- Completion of the Workplan
- Selection and purchase of land for the RFO production facilities
- Construction and operation of the RFO production facilities

Quantification of GHG reduction measures can be accomplished once final site design is established.

## 1.3. Approach to Developing the PCAP

The Tribe used the following steps to develop the PCAP:

1. Development of a QAPP that defined what GHG emission data would be collected, how it would be collected, and how it would be used. The Tribe used EPA's Optional Template for Tribal Quality Assurance Plans (July 31, 2023).
2. Development of GHG Inventory using EPA's Tribal Greenhouse Gas Reporting Tool (June 2023).
3. Collection of GHG emission data as set forth in the QAPP.
4. Reduction of collected GHG emission data to support the input needs of the TGIT. Assumptions made to reduce the data were recorded.
5. Inputting GHG emissions data into the TGIT.
6. Surveying Tribe members to understand their priorities with respect to climate pollution reduction.
7. Reviewing GHG emissions inventory results to prioritize greenhouse gas emissions reduction measures.
8. Using emission factors to quantify the reduction of criteria and hazardous air pollutants resulting from reduced fossil fuel and mixed grid electricity generation.
9. Assimilating the information into the PCAP using EPA's Draft Priority Climate Action Plan: An Outline for Tribes and Territories (December 2023).
10. Identifying Workplan development for RFO facility siting and construction as priority actions.

## 1.4. Scope of the PCAP

The scope of the PCAP includes all current operations on property under Tribal or Tribal member[2] control comprising approximately 517 acres in California; however, the larger vision for the Tribe is to either use existing land or acquire additional land for the construction of RFO production facilities that uses RTP Technology. To achieve this goal, the Tribe will continue to develop the Workplan described in Section 1.1 to support development of the required CCAP. The CCAP will be based on Workplan deliverables and reflect specific, quantifiable GHG emissions reductions associated with reductions in fossil fuel and electricity consumption and the significantly larger reduction in GHG emissions associated with the production and use of RFO.

# 2. Tribal Organization and Considerations

Habematolel Pomo of Upper Lake, as a federally recognized Indian Tribe, is an Eligible Entity for CPRG funding under Section 60114 of the Inflation Reduction Act.

Our Tribe has fought long and hard to preserve our land, culture, and environment. In 1907, Upper Lake Rancheria, was federally recognized to benefit a group of homeless and landless Pomo Indians. The Tribe's over 500 acres of lands were held in trust until the 1950s, when the U.S. Government's failed policy of forced assimilation attempted to terminate the trust relationship with many Indian tribes, including the Upper Lake Rancheria. Tribal lands were allotted or sold during termination. Many Tribal members who received allotments, who were uneducated on such matters and thus ill prepared to pay taxes on property, had their lands seized or sold for pennies on the dollar. The Tribe sued for wrongful termination in the 1970s and won its initial lawsuit in the 1980s. After decades of battles, Habematolel finally re-established its government and adopted its modern constitution in 2004. The Tribe acquired and placed into trust 11.24 acres in 2008 and has a court order for mandatory fee-to-trust acquisition for its historic reservation area due to the wrongful attempt at termination. The Tribe has just recently placed another 10 acres into trust.

The HPUL operates under a formal constitution as amended on November 5, 2019. Article IV of the constitution establishes an elected seven-member Executive Council as the Governing Body for the Tribe. Article X of the constitution establishes the powers of the Executive Council. In short, Article X grants the Executive Council full authority to conduct the affairs of the Tribe, including the activities contained in this PCAP and contemplated in the CCAP.

Since its modern rebirth, the Habematolel have established a gaming operation which has provided some job opportunities for Tribal members and the local community. However, due to the Tribe's remote location and saturated market, the gaming operation has only serviced its debt and is not yet producing any governmental revenues. Therefore, the Tribe has looked to ecommerce and other investments, such as our venture into biofuels technology, to find new ways to fund Tribal government programs and build a sustainable Tribal economy to advance our governmental objectives. The Tribe recognizes that the only way to build a secure future is by diversifying its economy.

[2] Some individual Tribal member lands are held in trust by the federal government and within the exclusive jurisdiction of the Tribe.

In its efforts to diversify its economy and contribute to fighting climate change that has severely impacted our reservation area, the Tribe, through its wholly owned entity HPUL Green Energy, has secured access to proprietary and patented technology which converts residual non-food biomass from the forest and agricultural sectors to high yields of light liquids. This technology produces a renewable fuel oil, or RFO® product, a petroleum replacement that is used for heating and cooling and may also serve as a feedstock for refineries. The RTP Technology has produced over 37 million gallons of renewable fuels and chemicals from wood residues in over 160,000 hours of successful unit operation—the equivalent of nearly 18 years of continuous production.

The Tribe's plans include an RTP unit for biofuels production for internal use and external sales. Available timber and associated commercial slash could be harvested on a sustainable basis, with trees replanted according to a schedule to ensure continued carbon absorption, and the slash would be used as feedstock. The Tribe is also evaluating purchasing additional property with convenient access to wood wastes, including in Maine, Washington, and Minnesota. The planned facility in Maine has already received an air permit and is in active development. In all cases, sustainable biomass would be used as feedstock for the planned RFO facilities.

## 2.1. Tribal PCAP Management and Development Team

The Tribal PCAP Management and Development Team is the same team identified in the QAAP and summarized in Table 1.

*Table 1: PCAP Management and Development Team*

| Name | Organization | Role |
|---|---|---|
| Sherry Treppa | HPUL | Grantee Sr. Approver, Chairperson of the HPUL Executive Council |
| Rodney Williams | HPUL (JTW Law) | Grantee Project Manager |
| Daniella Cazares | HPUL | Grantee Task Leader |
| Mike Riley | HPUL (TRC) | Grantee Task 1 Technical Leader, Mobile Combustion Source Data Assimilation and Reduction |
| Mike Riley | HPUL (TRC) | Grantee Task 2 Technical Leader, Electric Power Consumption Data Assimilation and Reduction |
| Mike Riley | HPUL (TRC) | Grantee Task 3 Technical Leader, Urban Forestry Data Assimilation and Reduction |
| Mike Riley | HPUL (TRC) | Grantee Task 4 Technical Leader, Tribal Greenhouse Gas Inventory Tool |
| David Elam | HPUL (TRC) | Grantee Quality Assurance Manager |
| John Murphy | HPUL (CGE) | Grantee Technical Project Coordinator |

**Sherry Treppa (HPUL)** provided overall management of the PCAP effort and was the interface between the PCAP team and the Executive Council. She monitored the work of the PCAP team, reviewed PCAP team recommendations, and presented PCAP team recommendation to the

Executive Council for approval. The Executive Council organization and powers are discussed in Section 2.

**Rodney Williams (JTW Law)** served as Project Manager for the PCAP effort and assisted with the collection of data for the PCAP and reviewing and commenting on this document. Rodney also designed and administered the Priority Climate Action Plan Survey for the Tribe.

**Daniella Cazares (HPUL)** served as Task Leader and assisted the Project Manager with data collection and coordinated data transmission to the Technical Task Leader.

**Mike Riley (TRC)** served as the Technical Leader for assimilation and reduction of TGIT data and for entering data into the TGIT.

**John Murphy (CGE)** served as the Technical Project Coordinator with responsibility for advancing development of the Workplan for the planned RFO facility.

**David Elam (TRC)** served as Quality Manager for the PCAP effort and reviewed the TGIT inputs and outputs and directed the production of this document.

## 2.2. Special Considerations

As discussed in Section 2, Tribe's leadership recognizes the need for economic diversification and has chosen renewal energy opportunities that align with the core values of the Tribe. Tribal leadership plans to pursue renewable energy opportunities by securing RTP technology and planning the development of RFO production facilities. It is important to note that Tribe leadership is not operating in a vacuum with respect to its climate action plans for the Tribe. Tribal members were surveyed to understand their climate action priorities. The survey questionnaire and results provided in Appendix D. The prioritized ranking of survey responses is provided in Table 2. Highlighted topics align with priority greenhouse gas emissions reduction measures which include energy efficiency improvements, development of renewable and alternative energy sources, production of biofuels from forest slash to reduce wildfire risk, and reduction in solid waste generation.

*Table 2: Prioritized Ranking of Priority Climate Action Plan Survey Results*

| Topic | Score |
|---|---|
| Ensure access to adequate food sources for all | 103 |
| Reduce littering and illegal dumping | 102 |
| Develop programs to reduce forest slash to mitigate the risk of wildfire | 100 |
| Maintaining access to clean water and improving water quality | 98 |
| Adopt energy efficiency standards in buildings | 97 |
| Develop more access to and encourage alternative energy systems (solar, wind, etc.) | 96 |
| Examine the impact of extreme weather events on disaster response, access to critical services, transportation, housing, and recovery services | 96 |

| Topic | Score |
|---|---|
| Prioritize renewable energy sources that convert forest floor materials (forest slash) into biofuels while also mitigating forest fire risk | 93 |
| Inclusion of climate risk and environmental impact review in Tribal planning and decision making | 93 |
| Develop conservation/preservation programs for lakes, waterways, and other ecologically sensitive areas | 92 |
| Implement programs to teach Climate and Resilience Health Awareness | 92 |
| Make recycling easier and more accessible | 91 |
| Reduce waste generated by the Tribal government and Tribal businesses | 90 |
| Provide cooling and heating centers during extreme temperature events | 90 |
| Prioritize clean energy job creation | 89 |
| Implement programs to target reductions in commercial waste | 88 |
| Plant more trees | 88 |
| Implement composting programs for Tribal members and Tribal businesses | 87 |
| Create programs to address airborne pollutants and emerging air quality issues | 86 |
| Develop programs designed to protect area pollinator species | 85 |
| Expand public transit options | 80 |
| Increase the number of people using public transit | 77 |
| Encourage the use of shared mobility options (bike share, carpooling, ride share) | 77 |
| Expand the number of electric vehicle (EV) charging stations (public and private options) | 72 |
| Replace gas-powered vehicles with electric vehicles in the Tribal fleet | 64 |

## 2.3. Collaborations

Development of the PCAP has been a collaborative effort involving representatives from the Tribe, the Tribal business general counsel (JTW Law), CGE, TRC, and EPA Region IX. Tribal leadership has provided the vision for participation in EPA's CPRG program. JTW Law has provided critical guidance for the development of program documentation and correspondence. CGE continues to advance the Workplan and provide required support for the long-term vision for a Tribally owned and operated RFO facility. TRC has provided technical support with the development of the QAPP and preparation of the GHG Inventory and PCAP. EPA Region IX (and contractors) has been generous in guidance with respect to grant applications and document reviews.

The Tribe has a robust outreach program on a sovereign-to-sovereign basis. The Tribe has met with the Attorney General of California, California legislators (state and federal), and federal legislators from Maine and Washington. The Tribe intends to request letters of support from local and national leaders.

# 3. PCAP Elements

## 3.1. Greenhouse Gas Emission Inventory

The GHG Emissions Inventory was prepared by obtaining data from a variety of sources including:

- Electricity Usage: PG&E, provided by Danielle Cirelli, HPUL
- Propane Usage: Ferrellgas, provided by Danielle Cirelli, HPUL
- Vehicle Fleet info: Anthony Arroyo, HPUL
- Solid Waste Disposal: Christopher Vieceli, Running Creek Casino
- Well and Septic: Rodney Williams, JTW Law
- Land Use Maps: Rodney Williams, JTW Law

The raw data were processed to yield input data suitable for use with the TGIT. Appendix D summarizes TGIT input data and associated assumptions. These data were then entered into the TGIT Community Module for production of a GHG Emissions Inventory for the Tribe. TGIT results are summarized in Figure 1.

Notably, approximately 65% of Tribal GHG emissions are associated with electricity consumption and fossil fuel usage for vehicles and building heating. This represents a key opportunity for priority action, and the Tribe plans to explore energy efficiency options for buildings and improved fleet management practices.

Methane emissions from wastewater treatment represent approximately 17.5 % of Tribal GHG emissions. Short of reducing septic tank count and throughput, there is little opportunity for GHG reduction in this area.

Methane emissions associated with solid waste disposal represent approximately 17% of Tribal GHG emissions. This is another area for priority action, and the Tribe plans to improve recycling programs and explore commercial composting of food wastes.

*Figure 1: HPUL GHG Emissions Inventory Summary*

## Inventory Emissions Summary

Return to Table of Contents

Please use the drop-down menu in the Scope 2 Emissions Selection box to determine which scope 2 emissions methodology is used in the summary tables below.

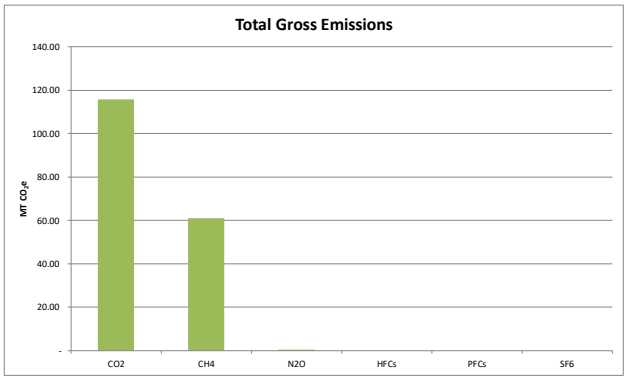
| Scope 2 Emissions Selection: | Market Based |
|---|---|
| 0.59 | Per capita Emissions for Habematolel Pomo of Upper Lake(MT CO2e/person) |

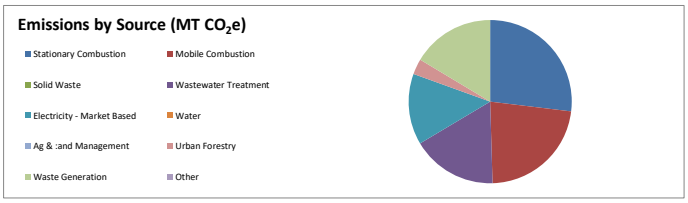
**Total Emissions (MT $CO_2e$)**

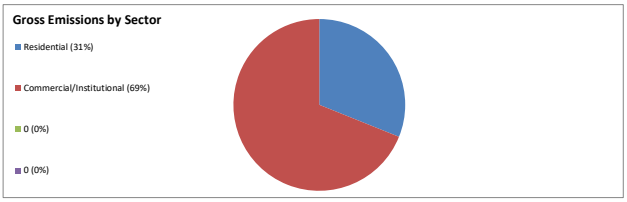
| | $CO_2$ | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Total MT $CO_2e$ | Percent of Total |
|---|---|---|---|---|---|---|---|---|
| Scope 1 | 90.19 | 31.01 | 0.30 | - | - | - | 121.49 | 69% |
| Scope 2 - Location Based | 25.59 | 0.04 | 0.05 | - | - | - | 25.69 | |
| *Scope 2 - Market Based (for informational purposes only)* | 25.59 | 0.04 | 0.05 | | | | 25.69 | 14% |
| Scope 3 | (5.64) | 30.00 | - | - | - | - | 24.36 | 14% |
| **Total Gross Emissions** | **115.78** | **61.05** | **0.35** | - | - | - | **177.18** | **97%** |
| **Total Net Emissions** | **110.14** | **61.05** | **0.35** | - | - | - | **171.54** | **97%** |

**Emissions by Source (MT $CO_2e$)**

| Source | $CO_2$ | $CH_4$ | $N_2O$ | HFCs | PFCs | $SF_6$ | Total | Percent of Total |
|---|---|---|---|---|---|---|---|---|
| Stationary Combustion | 49.02 | 0.07 | 0.12 | - | - | - | 49.21 | 28% |
| Mobile Combustion | 41.16 | 0.02 | 0.17 | - | - | - | 41.35 | 23% |
| Solid Waste | - | - | - | - | - | - | - | 0% |
| Wastewater Treatment | - | 30.93 | - | - | - | - | 30.93 | 17% |
| Electricity - Location Based | 25.59 | 0.04 | 0.05 | - | - | - | 25.69 | |
| *Electricity - Market Based (for informational purposes only)* | 25.59 | 0.04 | 0.05 | | | | 25.69 | 14% |
| Water | - | - | - | - | - | - | - | 0% |
| Ag & Land Management | - | - | - | | | | - | 0% |
| Urban Forestry | (5.64) | - | - | | | | (5.64) | -3% |
| Waste Generation | - | 30.00 | - | | | | 30.00 | 17% |
| **Total (Gross Emissions)** | **115.78** | **61.05** | **0.35** | - | - | - | **177.18** | **100%** |
| **Total (Net Emissions)** | **110.14** | **61.05** | **0.35** | - | - | - | **171.54** | **100%** |

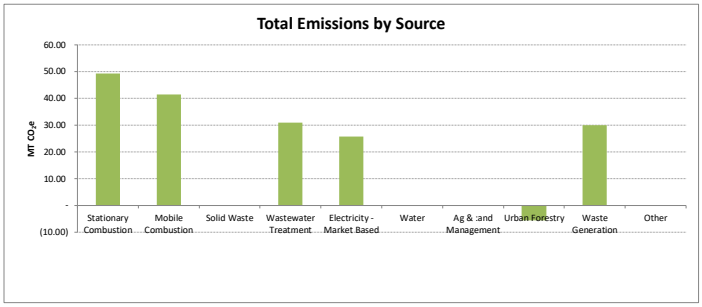


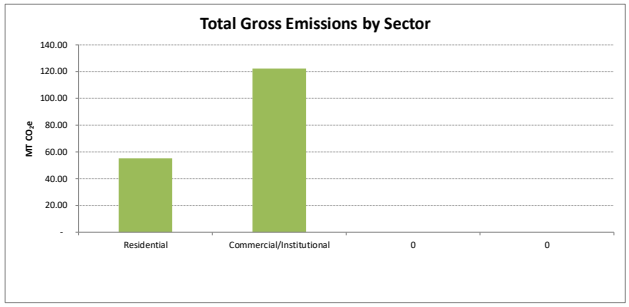




**Gross Emissions by Sector**

| Sector | Total (MT $CO_2e$) | Percent of Total |
|---|---|---|
| **Residential** | 55.06 | 31% |
| **Commercial/Institutional** | 122.12 | 69% |
| **0** | - | 0% |
| **0** | - | 0% |
| **Total** | **177.18** | **100%** |




**Total Emissions by Sector and Source (MT $CO_2e$)**

| Sector | Stationary | Electricity | Mobile | Solid Waste | Waste water | Water | Agriculture & Land Management | Urban Forestry | Other | TOTAL GROSS | TOTAL NET |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Residential** | 37.72 | 17.34 | - | - | - | - | - | (5.64) | - | 55.06 | 49.42 |
| **Commercial/Institutional** | 11.49 | 8.35 | 41.35 | 30.00 | 30.93 | - | - | - | - | 122.12 | 122.12 |
| **0** | - | - | - | - | - | - | - | - | - | - | - |
| **0** | - | - | - | - | - | - | - | - | - | - | - |
| **Total** | 49.21 | 25.69 | 41.35 | 30.00 | 30.93 | - | - | (5.64) | - | **177.18** | **171.54** |

## 3.2. GHG Emissions Projections

To be provided in CCAP

## 3.3. GHG Reduction Targets

To be provided in CCAP

## 3.4. Priority GHG Reduction Measures

The planned Priority GHG Reduction Measures are:

1. Reduce electricity consumption by 10% on existing Tribal property.
2. Reduce fossil fuel for building use by 10% on existing Tribal property.
3. Reduce fossil fuel consumption for transportation by 10% for existing Tribal vehicle fleet.
4. Reduce solid waste generation by 10% on existing Tribal property.
5. Complete the Workplan for the RFO facilities.
6. Select and purchase the properties for the RFO production facilities. The locations will be defined by the Workplan.
7. Construct and operate the RFO production facilities. The locations will be defined by the Workplan.

## 3.5. Benefits

The planned priority GHG reduction measures for current Tribal operations (i.e., reducing electricity and fossil fuel consumption and reducing solid wastes) will reduce GHG emissions by approximately 10% (approximately 14 metric tons) while also reducing operating costs for Tribe, reduce GHG emissions from Tribal operations and at the same time reduce emissions of a number of co-pollutants associated with fossil fuel consumption and mixed-grid electricity generation.

The construction and operation of the RFO facilities will produce significant GHG emissions, the total of which will be defined by aggregate capacities of the facilities. Based upon analysis using the GHGenius model from (S&T)[2] Consultants Inc., for every 100,000 MMBtu of natural gas that is displaced by RFO product, a GHG reduction of approximately 5,222 $MTCO_2e$ is realized, if used for boiler fuel.

Approximately 51% of HPUL GHG emissions are due to non-renewable fuel combustion (Scope 1). Table 3 presents the anticipated reduction in co-pollutants per metric ton GHG reduced.

*Table 3: Amount Co-Pollutant Reduced by Reduction of one Metric ton GHG**

| Gasoline Use | |
|---|---|
| **Criteria Pollutant** | **TPY reduction** |
| PM | 6.64E-04 |
| PM10 | 6.64E-04 |
| PM2.5 | 6.64E-04 |
| NOX | 1.08E-02 |
| CO | 6.57E-03 |

| Natural Gas Use | |
|---|---|
| **Criteria Pollutant** | **TPY reduction** |
| PM (Total) | 4.78E-06 |
| PM (Filterable) | 1.84E-06 |
| PM (Condensable) | 2.94E-06 |
| PM2.5 (Total) | 3.95E-06 |
| PM2.5 (Filterable) | 1.01E-06 |

| Gasoline Use | |
|---|---|
| **Criteria Pollutant** | **TPY reduction** |
| SOX | 5.57E-04 |
| TOC Total | 2.01E-02 |
| **HAP/TAP** | Lb./yr. Reduction |
| Acetaldehyde | 1.02E-02 |
| Formaldehyde | 1.57E-02 |
| Total HAP | 2.58E-02 |

| Natural Gas Use | |
|---|---|
| **Criteria Pollutant** | **TPY reduction** |
| SO2 | 5.51E-06 |
| NOX | 2.94E-04 |
| CO | 7.71E-04 |
| TOC | 1.01E-04 |
| VOC | 5.05E-05 |
| Total HAP | 3.33E-02 |

*Estimated using AP-42 Sections 1.5 and 3.3.

Approximately 14% of HPUL GHG emissions result from electricity consumption (Scope 2). The utility serving the HPUL community is Pacific Gas and Electric (PG&E).

Based on the values provided in Table 3 the planned priority GHG reduction measures associated with current operations, reductions in co-pollutants are modest; however, once the RFO facility is constructed and delivering RFO to the market, a GHG reduction of approximately 5,222 $MTCO_2e$ (5,744 tons) will be realized for every 100,000 MMBtu of natural gas that is displaced by RFO product as boiler fuel. Based on the values in Table 3, this corresponds to a reduction in PM, SO2, NOX, CO, and TOC emissions of 0.25, 0.03, 1.5, 4.0, and 0.5TPY, respectively.

The energy resource mix for PG&E is presented below:

- Nuclear: 49.3%
- Solar: 22.0%
- Wind: 9.4%
- Hydro: 9.4%
- Natural Gas: 4.8%
- Biomass: 4.6%
- Geothermal: 0.5%

Of these energy sources, only natural gas and biomass may be expected to emit co-pollutants. Given that less than 10% of the electricity consumed by the HPUL is derived from these resources, and the low percentage of HPUL GHG emissions resulting from electricity use, significant reductions in co-pollutants resulting from reductions in Scope 2 GHG emissions are not anticipated.

## 3.6. Review of Authority to Implement

As noted in Section 2, The HPUL operates under a formal constitution as amended on November 5, 2019. Article IV of the constitution establishes an elected seven-member Executive Council as the Governing Body for the Tribe. Article X of the constitution establishes the powers of the Executive Council which includes the authority to conduct the affairs of the Tribe, including the activities contained in this PCAP and contemplated in the CCAP.

## 3.7. Identification of Other Funding Mechanisms

The Tribe would directly fund energy efficiency improvements and the reduction in solid waste generation from the CPRG Implementation Grant. Recognizing that RFO projects are capital intensive, the Tribe and its alliance partners have identified additional funding mechanisms to ensure full implementation of the PCAP and CCAP plans. For instance, the Tribe's Maine project will use tax exempt municipal bond funding, CPACE funding along with other grant proceeds. The Tribe and its partners will also explore private sources of funds as needed and available.

## 3.8. Workforce Planning Analysis

The Tribe expects to employ at least three additional employees to implement its plans on and near the reservation regarding energy efficiency and solid waste reduction. Each RFO site (including the potential site in the reservation area) will bring additional economic benefits to the Tribe and surrounding community. For instance, the estimated economic impacts from siting a new RFO product facility in Washington are highlighted below:

- **Construction Jobs** – 70 Full-time jobs
- **Indirect Economic Activity from Construction** – 55 jobs
- **Facility Operation** – 189 permanent jobs; 62 jobs in the forestry sector; 24 full-time staff at the production facility; and 103 jobs from indirect and induced economic activity in a wide range of sectors throughout the region's economy.
- **Construction of RFO Facility** – $7.4 million in new income to residents, with $4.2 million of this income coming from activities directly related to the construction and the remainder arising from the stimulus of this activity on the region's economy.
- **Operation of RTP Facility** – $2.3 million in new income annually through direct forest sector jobs; $1.6 million annually through facility operations; and $6.6 million annually through other indirect and induced economic activity.

# 4. Next Steps

The Tribe is prepared to implement the PCAP immediately in accordance with the following steps:

1. Communicate the results of the HPUL Climate Action Plan Survey to the Tribal community and communicate how it influenced PCAP development.
2. Communicate planned PCAP activities.
3. Implement improved recordkeeping systems for fossil fuel usages and create tools to visualize consumption.
4. Conduct an energy efficiency study to identify the most cost-effective options for reducing electricity and fossil fuel use at the casino.
5. Inventory solid waste generation at the casino to identify waste streams that are candidates for recycling, reduction, or composting.
6. Develop communication tools that help individual Tribal members understand how they can reduce solid waste and increase recycling.

7. Proceed with the development and execution of the Workplan including plans for energy efficiency, solid waste reduction, and biofuel production facilities.

# Appendix A

HPUL CPRG Program Application

**HPUL Climate Pollution Reduction Plan**
**Habematolel Pomo of Upper Lake**
**June 15, 2023**

# I. EXECUTIVE SUMMARY

## Proposal

Habematolel Pomo of Upper Lake, a federally recognized Indian tribe (the "Tribe"), owns an equity position in CastleRock Green Energy, LLC ("CGE"). CastleRock Biofuels, LLC, which is owned by CGE and Ensyn Corporation ("Ensyn"), through a newly formed subsidiary ("CGE-WA"), wishes to determine the feasibility of developing a biomass to biofuels project in Western Washington that would contribute towards addressing the impacts of climate change by reducing greenhouse gas ("GHG") emissions. Our Pomo culture, similar to that of other tribes, has always stressed the importance of proper stewardship of our lands and natural resources. The Tribe's dedicated EPA department has long advocated the importance of protecting the environment and natural resources to the benefit of generations to come long after us. It is for this reason the Tribe wishes to study the potential positive impacts of a biofuels project on the potential reduction of greenhouse gases and respectfully requests funding under this Application. The Tribe intends to develop a Priority Climate Action Plan as part of developing a Comprehensive Climate Action Plan that protects the Tribe and its resources—a major component of which includes climate protection through limiting greenhouse gas (GHG) through projects like the one being studied.

In its planning study, the Tribe expects that the necessary ingredients appear to be present for a successful project which would convert unwanted (and dangerous) forest residues (i.e., slash) into biofuel using Ensyn's proprietary commercial rapid pyrolysis process or Rapid Thermal Processing ("RTP® Technology" or "RTP"). The biofuel may be used as a heating oil replacement in commercial boilers or as a feedstock at refineries.

In addition to the immediate investment goals and commercial goals of the Tribe (in partnership with CGE and Ensyn), one of our most important goals is to re-acquire land that we have lost, and to use and develop that land in a sustainable fashion in keeping with our proud history. At a minimum, this could include using a portion of the land for the development of our own RTP unit for the production of biofuels to be used internally and to be sold externally. Available timber and associated commercial slash could be harvested on a sustainable basis, with trees replanted according to a schedule to ensure continued carbon absorption, and the slash would be used as feedstock. We will also pursue additional carbon sink opportunities, including applications in ag tech and regenerative farming.

The study workplan will determine the preliminary feasibility of locating a biofuel production facility at or near Shelton, Washington, in an area strategically located in the vicinity of several large industrial timber owners that could supply the needed feedstock and could also convert slash from any future forest management plans designed. Such residues qualify as "Renewable Biomass" under the Renewable Fuel Standard ("RFS") program. Use of this

feedstock would decrease the occurrence of devastating forest fires, while reducing GHG emissions by as much as 85%. The deliverables and elements in this workplan support EPA's Fiscal Year (FY) 2022-2026 Strategic Plan Goal 1 (Tackle the Climate Crisis).

The workplan will include:

1. Evaluating the most promising site or sites based on the following factors:
    a. Access to the necessary infrastructure, utilities, etc.
    b. Access to feedstocks that can be economically transported
    c. Ease of permitting
    d. Ability of site control to initiate permitting

2. Studying the potential impacts of reducing GHG emissions by converting potential GHG emission sources into a carbon neutral fuel including potential slash from future forest management projects that reduce the likelihood and impacts of future forest fires.

3. Outlining a permitting strategy.

4. Identifying and analyzing infrastructure alternatives to economically access both heating oil and refinery customers.

5. Conducting Offtake Market Survey, including identification and negotiation with:
    a. Potential customers of renewable heating oil produced using the RTP Technology, including the following:
        i. Centrio
        ii. University of Washington
        iii. City of Eugene
    b. Potential refinery customers.

6. Conducting Feedstock Survey to achieve goal of understanding the dynamics of assisting in future forest management by providing a carbon neutral biomass disposal option, including identification and negotiation with:
    a. Large landowners
    b. Potential logging and trucking partners.

7. Determining any social/political factors to be addressed, as well as identifying potential consultants that may increase the likelihood of the project's success.

## II. DESCRIPTION OF ELIGIBLE ENTITY APPLYING FOR THE EPA CLIMATE POLLUTION REDUCTION PLANNING GRANT AND QUALIFICATIONS OF KEY PERSONNEL

Habematolel Pomo of Upper Lake, as a federally recognized Indian Tribe, is an Eligible Entity under Section 60114 of the Inflation Reduction Act and, therefore, qualified to submit this Application.

Our Tribe has fought long and hard to preserve our land, culture and environment. In 1907, Upper Lake Rancheria, was federally recognized to benefit a group of homeless and landless Pomo Indians. The Tribe's over 500 acres of lands were held in trust until the 1950s, when the U.S. Government's failed policy of forced assimilation attempted to terminate the trust relationship with many Indian tribes, including the Upper Lake Rancheria. Tribal lands were allotted or sold during termination. Many Tribal members who received allotments, who were uneducated on such matters and thus ill prepared at paying taxes on property, had their lands seized or sold for pennies on the dollar. The Tribe sued for wrongful termination in the 1970s and won its initial lawsuit in the 1980s. After decades of battles, the Habematolel finally re-established its government and adopted its modern constitution in 2004, acquired and placed into trust 11.24 acres in 2008 and has a court order for mandatory fee-to-trust acquisition for its historic reservation area due to the wrongful attempt at termination. The Tribe has just recently placed another 10 acres in trust.

Since its modern rebirth, the Habematolel have established a gaming operation which has provided some job opportunities for Tribal members and the local community. However, due to our remote location and saturated market, the gaming operation has only serviced its debt and is not yet producing any governmental revenues. Therefore, the Tribe has looked to ecommerce and other investments, such as our venture into biofuels technology, to find new ways to fund Tribal government programs and build a sustainable Tribal economy to advance our governmental objectives. The Tribe recognizes that the only way to build a secure future is by diversifying our economy.

At a minimum, this could include using a portion of the land for the development of our own RTP unit for the production of biofuels to be used internally and to be sold externally. Available timber and associated commercial slash could be harvested on a sustainable basis, with trees replanted according to a schedule to ensure continued carbon absorption, and the slash would be used as feedstock. But we will also pursue additional carbon sink opportunities, including applications in ag tech and regenerative farming.

In its efforts to diversify its economy and contribute to fighting climate change that has severely impacted our reservation area, the Tribe has invested in CGE. Through this investment, the Tribe has gained access to Ensyn's core technology, the RTP Technology, which converts residual non-food biomass from the forest and agricultural sectors to high yields of light liquids. Ensyn's RTP Technology produces a renewable fuel oil, or RFO® product, a petroleum-replacement that is used for heating and cooling and may also serve as a feedstock for refineries. The RTP Technology has produced over 37 million gallons of renewable fuels and chemicals from wood residues in over 160,000 hours of successful unit operation—the equivalent of nearly 18 years of continuous production.

Ensyn has established alliances with world-class industry leaders to advance its technologies and business plan:

- Technology: Ensyn's broad technology alliance with Honeywell UOP facilitates engineering and supply of production equipment to new projects and supports the commercialization of refinery applications.
- Production: Production expansion is enabled by alliances with leading fiber producers, including Suzano (NYSE: SUZ), the world's largest pulp producer, for Brazil.
- Offtake: Ensyn is negotiating with several of the world's largest refiners regarding product use, anchoring plans for product sales.

Ensyn's intellectual property is anchored by a robust portfolio of patents covering a range of significant aspects of the RTP process as well as related applications. Ensyn's patent strategy aligns with Ensyn's business focus on continuous development. As innovations and improvements emerge, new patents are filed. In addition, with over 30 years of commercial operations and technology development, Ensyn also has accumulated significant know-how associated with RFO product production and its applications.

Ensyn has designed and commissioned 16 licensed facilities (from pilot to commercial scale) over the last 30 years for the production of chemicals and heating fuels and for testing and product development. Five commercial biomass-processing facilities currently employ the RTP Technology.

The initial commercial-scale production facility employing the RTP Technology is located in Renfrew, Ontario. Initially conceived as a demonstration facility, it was converted to commercial operation and now has nine years of commercial operation, with a capacity of three million gallons/year of RFO product. The output from that facility is currently being used for chemical applications and as RFO product for heating and cooling. The Renfrew facility has been qualified by EPA under the RFS program. Sales of RFO from Renfrew to U.S. customers are eligible to generate Renewable Identification Numbers ("RINs") under that program.

Ensyn has been generating RINs from the sale of RFO product to Memorial Hospital, located in New Hampshire, since 2014 – nearly nine years – and has supplied Bates College with heating oil for five heating seasons.

Therefore, the Habematolel and CGE, through its partnership with Ensyn, collectively have the experience, established record and qualifications to successfully study and potentially develop this proposed joint project.

A table identifying the project participants for the proposed biofuels planning study is below:

| **Organization Name** | **Organization Address** | **Administrative Role** | **Scope of Work** | **Proposed Funding Amount** |
|---|---|---|---|---|
| Habematolel Pomo of Upper Lake | P.O. Box 516 Upper Lake, CA 95485 | Applicant | Prepare and submit application; ensure Project is consistent | $200,000 |

| | | | | |
|---|---|---|---|---|
| | | | with grant requirements; administer grant post-award; funds management and reimbursement; compliance and reporting for the Project; study and report on feasibility of the proposed biofuels Project to reduce greenhouse gas emissions; provide reports, as described in the deliverables on Project outcomes; engage contractors and professionals to study and report on potential impacts of a biofuels Project on the reduction of greenhouse gases. | |

The elected Executive Council of the Habematolel Pomo of Upper Lake will be responsible for the implementation and oversight of this grant opportunity.

The Tribal Resolution authorizing the application for this funding is attached.

## III. PROPOSED UTILIZATION OF CLIMATE REDUCTION PLANNING GRANT

*Objective*

The Climate Reduction Planning Grant will be utilized by the Tribe to study the feasibility and environmental impacts (including the potential reduction of GHG through the implementation of a biofuels project, described in more detail below. The Tribe believes by implementing this biofuels project, they can meet the twin goals of economic diversification and responsible environmental stewardship. As part of this process, the Tribe will develop a Priority Climate Action Plan as well as a Comprehensive Climate Action Plan.

*Activities to be funded*

The Tribe plans to fund a planning study which will measure the feasibility of implementing a biofuels project in State of Washington. This study will determine if the project will promote economic self-sufficiency, reduce GHG emissions and advance positive changes for climate protection. This study will measure (1) the number of potential jobs created (both for Tribal members and the impacted communities); (2) the economic impact to the Tribe and its economy; and (3) the specific measured impact on the reduction of GHG emissions. This study will aid the Tribe, in consultation with the Tribe's EPA department as well as other outside stakeholders, develop both a Priority Climate Action Plan and a Comprehensive Climate Action Plan.

The Tribe will contract with expert third parties to provide the data and research for this study. It is anticipated that all of the work in the budget will be completed in 150 days.

*Eligible use of the proposed funding*

The project budget is $200,000.00 as detailed in the WorkPlan Budget

**Feasibility Study Budget (all tasks include travel expenses) - projected timeline of approximately 120 days:**

| | |
|---|---|
| Third party feedstock consultant - feedstock report | $ 35,000 |
| Siting Study - third party engineers - Siting Survey | $ 40,000 |
| Offtake options - internal review | $ 35,000 |
| Engineering Feasibility – third party consultant | $ 30,000 |
| Analytical and Modeling Services | $ 60,000 |
| Total | $200,000 |

## IV. PROJECT PLAN

**CGE-WA has obtained the right to use the RTP Technology of Ensyn for a biofuels facility in Western Washington.**

Through its investment in CGE, the Tribe gained access to Ensyn's core technology, the RTP Technology, which converts residual non-food biomass from the forest and agricultural sectors to high yields of light liquids. Ensyn's RTP Technology produces a renewable fuel oil, or RFO product, a petroleum-replacement that is used for heating and also may serve as a feedstock at refineries. The RTP Technology has produced over 37 million gallons of renewable fuels and chemicals from wood residues in over 160,000 hours of successful unit operation—the equivalent of nearly 18 years of continuous production.

Ensyn has designed and commissioned 16 licensed facilities (from pilot to commercial scale) over the last 30 years for the production of chemicals and heating fuels and for testing and product development. Five commercial biomass-processing facilities currently employ the RTP technology.

## Technology Overview

### *From unusable wood biomass to high-value liquid product*

Ensyn's patented RTP Technology uses heat to thermally crack carbon-based feedstocks, such as wood biomass (i.e., cellulose, lignin), into high yields of a higher-value liquid product. The RTP Technology typically converts dried wood to approximately 75% (by weight) liquid, with the balance converted to combustible gases and char. The technology allows the variance of relative yields in response to customer product requirements.

### *The key innovation of RTP is processing speed*

With RTP, conversion typically takes place in less than two seconds. This allows for the production of new, higher value products at high yields and with low capital costs.

### *The core RTP process does not employ high temperatures or excessive operating pressure*

The RTP pyrolysis process uses a hot "transported" bed (typically sand) circulating between two key vessels. Feedstocks, such as wood residues, are subjected to fast, intimate contact with the hot sand for a few seconds, resulting in the thermal cracking of the feedstock to gases and vapors. Product vapors are rapidly quenched, or cooled, and recovered as a light liquid product.

### *RTP represents a close analogue to equipment used in refineries worldwide*

Ensyn's RTP process operates as an analogue to Fluid Catalytic Cracking, or FCC, a very common and mature process used in most refineries around the world. An FCC system circulates catalyst in a closed loop between two key vessels to convert vacuum gas oil to gasoline. Ensyn uses a similar mechanical process, but typically circulates wood residues with readily available sand to convert the wood residues to high yields of a light liquid product.

### *Intellectual Property*

Ensyn's intellectual property is anchored by a robust portfolio of patents covering a range of significant aspects of the RTP process as well as related applications. Ensyn's patent strategy aligns with Ensyn's business focus on continuous development. As innovations and improvements emerge, new patents are filed. In addition, with over 30 years of commercial

operations and technology development, Ensyn also has accumulated significant know-how associated with RFO product production and its applications.

## Greenhouse Gas Profile

The RFS program has enabled Ensyn to price RFO product competitively with fossil fuels. Congress created this Federal program for purposes of U.S. energy security and not specifically for GHG reductions, unlike the state authorized carbon programs, such as the Renewable Portfolio Standards ("RPS") and other carbon programs that exist in California for liquid fuels (e.g., the Low Carbon Fuel Standard ("LCFS") portion of AB 32 Scoping Plan). As such, no "cradle to grave "tracking of GHG reductions that exists under the RFS program, is required to qualify for renewable energy credits ("RECs") or LCFS credits in various states. The differing systems allow for the monetization of the RINs while not encumbering the utilization of GHG reductions by customers or the monetization of RECs or LCFS credits (in areas where such programs exist) to further offset the costs associated with RFO product.

The RINs generated under the RFS program are critical to the economics related to the production and sale of RFO. The use of RFO product in a boiler to heat or cool interior spaces of homes or buildings to control ambient climate for human comfort qualifies for the generation of RINs that may be sold to customers registered under the RFS program. This has enabled Ensyn to sell RFO product to customers at a lower price than would be necessary in the absence of the RFS program.

With the exception of sawmill residuals from tree plantations, RFS qualified feedstocks presently tend to have little, if any, commercial value (very little stumpage pricing is included in the pricing of these feedstocks) and tend not to be subject to market based pricing volatility typical in the biomass space. Long-term price certainty and stability result from the use of these feedstocks, with the costs driven by the trucking, labor and equipment needed to harvest and process these feedstocks.

When compared to oil and natural gas, RFO product shows a significant reduction in life cycle greenhouse gases. Since only feedstock that meets the RFS program's definition of Renewable Biomass is used to manufacture RFO product, RFO product can be considered a carbon neutral fuel for purposes of GHG or fossil fuel abatement programs. Based upon analysis using the GHGenius model from (S&T)2 Consultants Inc., for every 100,000 MMBtu of natural gas that is displaced by RFO product, a GHG reduction of approximately 5,222 MTCO2eq is realized, if used for boiler fuel.

## Conversion Process

In addition to reducing GHG emissions by up to 85%, one of the other benefits of a customer's incorporating RFO product into its fuel mix as heating oil is the ability to use existing equipment, with only a modest capital requirement for retrofit conversions, as compared to the alternatives. No changes are required to be made to the actual boiler vessel itself.

A typical conversion to RFO product deals primarily with the handling and storage of the RFO product and the installation of a new burner and controls capable of multiple fuels. The typical conversion will include the following:

- A tanker unloading pump station
- Fuel storage - either lining existing tanks or installing new stainless-steel tanks
- Fuel circulation and fuel heating skid with all interconnected piping
- New burners for the number of units being converted, with each burner being capable of handling up to 3 fuels.

An RFO product customer also gains the added advantage of introducing a new layer of fuel optionality, as the boilers are retrofitted so that they may handle both RFO product and petroleum derived heating oil.

When compared to solid biomass, RFO product furthers adds the significant customer benefit of reducing operational expenses related to the handling of solid biomass. Solid biomass handling is only conducted at the RFO product production facility and is included in the cost to purchase RFO product.

## V. PROJECT ECONOMIC, ENVIRONMENTAL IMPACTS AND PERFORMANCE MEASURES

### Climate protection as a whole

Through the production of biofuel, it is estimated that every 20 million gallons per year would fully displace traditional fossil fuels currently being used, eliminating approximately 82,000 metric tons of carbon emissions annually – the equivalent of taking 17,775 cars of the road every year. This represents only half of the planned capacity in Washington.

### Habematolel Pomo of Upper Lake

The Tribe meets two objectives with the Project: (1) the Tribe furthers the goal of economic self-reliance and self-determination by participating in the positive economic returns of the Project as an equity owner; and (2) recognizing that climate change is a global issue and not just an issue contained to its reservation, the Tribe gains the added goal of reducing GHGs—an objective the Tribe considers critical to protecting its reservation area from the ravages of wild fires, drought and other impacts of climate change.

### State of Washington

Below, from a recently conducted impact study, are the estimated economic impact highlights that would result from the siting of a new RFO product manufacturing facility in Washington.

*Construction Jobs* – 70 Full-time jobs

*Indirect Economic Activity from Construction* – 55 jobs

*Facility Operation* – 189 permanent jobs; 62 jobs in the forestry sector; 24 full-time staff at the production facility; and 103 jobs from indirect and induced economic activity in a wide range of sectors throughout the region's economy.

*Construction of RTP Facility* - $7.4 million in new income to residents, with $4.2 million of this income coming from activities directly related to the construction and the remainder arising from the stimulus of this activity on the region's economy.

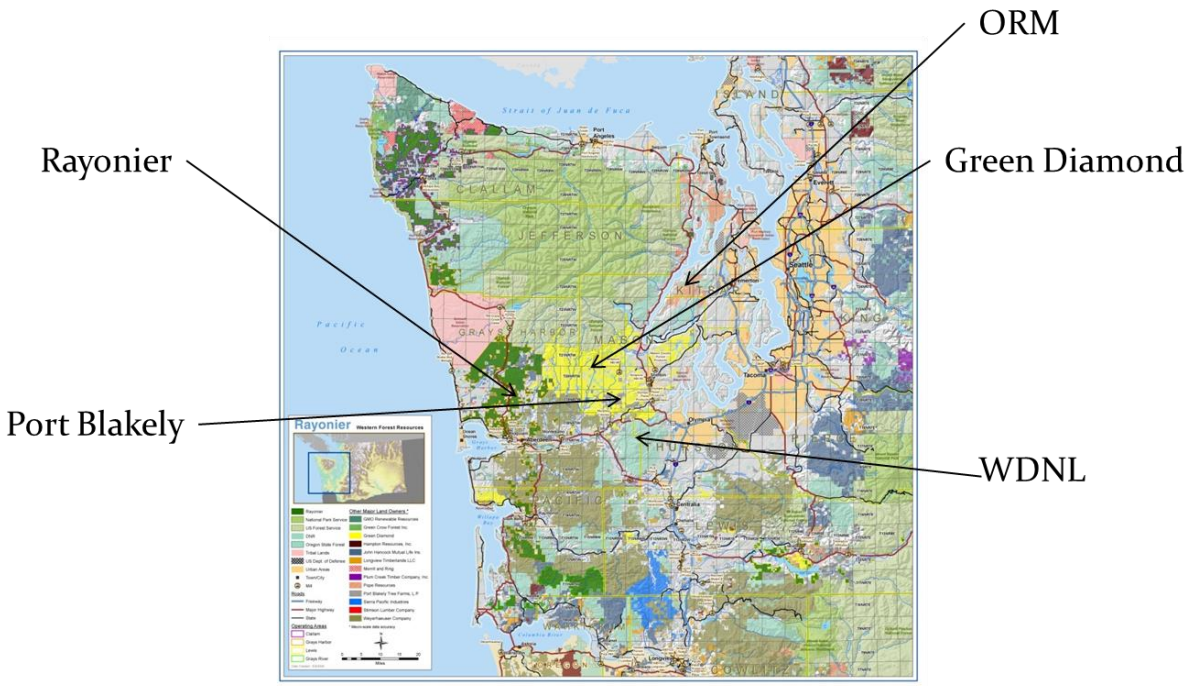
*Operation of RTP Facility* - $2.3 million in new income annually through direct forest sector jobs; $1.6 million annually through facility operations; and $6.6 million annually through other indirect and induced economic activity.

**Environmental**

The State of Washington's susceptibility to the challenges of climate change is well documented. By converting biowaste that would otherwise be a GHG emitter into a carbon-neutral fuel, the Project would aid in protecting Washington, the Tribe and other areas from the effects of climate change.

**Feedstocks**

The proposed project would be located in an area with one of the greatest number of large industrial timber owners in the U.S. (see the map below – each color represents a major timber owner)



The Project will investigate feedstock options to determine volumes, availability and potential terms to access the necessary RFS qualified feedstocks required for the facility. The process will require meetings with multiple landowners, loggers, and truckers.

**Offtake Markets**

A feasibility study of potential offtake markets will be essential. Both heating oil and potential refinery offtake will be estimated. It will also be necessary to identify any potential impediments or drivers, and to project the timing for the construction of the project. Site visits and meetings with principals will be required. Both the City of Seattle and the State of Washington are very proactive in GHG abatement programs.

1. Heating Oil targets:
    a. Centrio - driven by City of Seattle fossil fuel tax
    b. University of Washington - driven by standard GHG goals
    c. City of Eugene

2. Refinery Options:
    a. Anacortes refineries
    b. Others

3. Defining regulatory benefits that may be available as market drivers:
    a. RFS program
    b. Local LCFS programs
    c. City of Seattle fossil fuel tax

**Site Option**

Develop a first cut of potential site options available for the project. This will require meeting with local landowners, strategic partners, and local economic development and governmental groups to provide key direction.

**Preliminary Engineering**

Based upon Ensyn's standard plant design, prepare a preliminary site layout and produce a high-level cost estimate to feed into financial models.

**Financial Viability**

Develop a preliminary project financial model to facilitate a decision to proceed with a detailed project development program, including site acquisition, permit application and submittals, negotiation of feedstock supply contracts, offtake contract negotiations, exploring available funding resources, exploring potential strategic partnerships, and engaging in preliminary discussions with EPC contractors.

## VI. BUDGET NARRATIVE AND DETAILED JUSTIFICATION

*Budget Narrative*

The budget for the Climate Protection Planning Grant is $200,000. This funding will be directly administered by the Tribal Government. Funds may only be used for the following purposes:

1) To fund consultants and/or industry experts to study the feasibility (including the economic and environmental impacts) of the proposed biofuels project.
2) Travel for meetings with governmental officials and other key stakeholders (such as the State of Washington, local governmental officials and other sovereign tribal nations who may be directly impacted by the proposed project).
3) Site studies and engineering models to aid in the potential planning and feasibility of the proposed project.

The Tribal Council will oversee funds and reporting of the use of these funds.

No direct administrative costs are included within the budget.

## VII. CONCLUSION

Award of the grant funds requested herein will forever change the Tribe's ability to understand and appreciate its past, aid in protecting our environment and natural resources, increase the likelihood of reducing GHG emissions, and grow and thrive in the future, while facilitating the same for our surrounding community. We respectfully request that these funds be granted in the amount requested.

# Appendix B

Quality Assurance Project Plan (QAPP) for Habematolel Pomo of the Upper Lake Climate Pollution Reduction Plan

# Quality Assurance Project Plan for Habematolel Pomo of Upper Lake Climate Pollution Reduction Plan

**EPA Grant Number: 98T79501**

**October 23, 2023**


**Prepared by:**

Habematolel of Upper Lake
9470 Main Street
(P.O. Box 516)
Upper Lake, CA 95485

**Prepared for:**

US EPA Region 9
75 Hawthorne Street
San Francisco, CA 94105

# 1. Project Management (Group A)

## 1.1. Title and Approval Page

**Quality Assurance Project Plan for**
**Habematolel Pomo of Upper Lake Climate Pollution Reduction Plan**

Prepared by:
Habematolel Pomo of Upper Lake
9470 Main Street
(P.O. Box 516)
Upper Lake, CA 95485

Prepared for:
US EPA Region 9
75 Hawthorne Street
San Franciso, CA 94105

October 23, 2023

**APPROVALS:**

Sherry Treppa, Chairperson of the HPUL Executive Council — Date: October 24, 2023

David L. Elam, Jr., CMQ/OE, PMP — Date: October 23, 2023

USEPA Region 9 Grants Project Officer:
Kathryn Harper — Date: November 7, 2023

USEPA Region 9 Quality Assurance Manager:
Audrey Johnson — Date: November 7, 2023

**QAPP Revision History**

| Revision No. | Description | Author | Date |
|---|---|---|---|
| 0 | Original Version | QA Manager | 10/06/2023 |
| 1 | Version 1 | QA Manager | 10/23/2023 |
| | | | |

## 1.2. Table of Contents[1]



[1] For grantees who are not familiar with using MS Word's TOC functions, please review the video at https://www.youtube.com/watch?v=0cN-JX6HP7c. Accessed on 6/23/2023.

## List of Tables



## List of Exhibits

## Abbreviations

| | |
|---|---|
| CAA | Clean Air Act |
| CFR | Code of Federal Regulations |
| CCAP | Comprehensive Climate Action Plan |
| CGE | CastleRock Green Energy, LLC |
| CPRG | Climate Pollution Reduction Grant |
| CO2e | Carbon Dioxide Equivalents |
| Ensyn | Ensyn Corporation |
| EPA | U.S. Environmental Protection Agency |
| GHG | Greenhouse Gas |
| GHGRP | Greenhouse Gas Reporting Program (40 CFR Part 98) |
| HPUL | Habematolel Pomo of Upper Lake (Grantee Organization) |
| hr | Hour |
| ICR | Information Collection Request |
| JTW | John T. Williams Law |
| MPG | Miles per Gallon |
| MW | Megawatt |
| OAR | EPA Office of Air and Radiation |
| PCAP | Priority Climate Action Plan |
| PM | Project Manager |
| PO | EPA Project Officer for Grant |
| POP | Period of Performance |
| POR | EPA Project Officer's Representative |
| POTW | Publicly Owned Treatment Works |
| PWP | Project Work Plan |
| QA | Quality Assurance |
| QAM | Quality Assurance Manager |
| QAMD | Quality Assurance Manager Delegate |
| QAPP | Quality Assurance Project Plan |
| QC | Quality Control |
| RFO | Renewable Fuel Oil |
| TBD | To Be Determined |
| TGIT | Tribal - GHG Inventory Tool (provided by the EPA) |
| TL | Task Leader |
| yr | Year |

## 1.3. Distribution List

This section presents the primary staff who will be working on the project. These staff will be identifying existing[2] data resources for evaluation and potential use under the project or serving in project-specific roles for implementing the Quality Assurance Project Plan (QAPP). The listing in **Table 1.1** includes staff responsible for implementing independent internal quality management steps and staff serving in external oversight roles.

This QAPP and, as applicable, all major deliverables relying on existing data will be distributed to the staff presented in **Table 1.1.** Additionally, this QAPP will be provided to any unlisted staff who are assigned to perform work under this project. A secured copy of this QAPP will be maintained in the project files under the *//S/Grants/EPA CPRG/Quality_Management/QAPP* directory.

**Table 1.1** QAPP Distribution List

| Name | Organization | Role |
|---|---|---|
| Kathyrn Harper | US EPA, Region 9 | EPA Project Officer (PO) |
| Audrey Johnson | US EPA, Region 9 | EPA Quality Assurance Manager or Delegate |
| Sherry Treppa | HPUL | Grantee Sr. Approver, Chairperson of the HPUL Executive Council |
| Rodney Williams | JTW | Grantee Project Manager |
| Daniella Cazares | HPUL | Grantee Task Leader |
| Mike Riley | TRC | Grantee Task 1 Leader, Sr. Environmental Scientist |
| Mike Riley | TRC | Grantee Task 2 Leader, Sr. Environmental Scientist |
| Mike Riley | TRC | Grantee Task 3 Leader, Sr. Environmental Scientist |
| Mike Riley | TRC | Grantee Task 4 Leader, Sr. Environmental Scientist |
| David Elam | TRC | Grantee Quality Assurance Manager |
| John Murphy | CGE | Grantee Technical Project Coordinator |

[2] The term "existing data" is defined by the EPA's *Environmental Information Quality Policy* (CIO 2105.3) as "… data that have been collected, derived, stored, or reported in the past or by other parties (for a different purpose and/or using different methods and quality criteria). Sometimes referred to as data from other sources." The term "secondary data" may also be used to describe "existing data" in historical EPA quality-related documents.

## 1.4. Project/Task Organization

The primary personnel responsible for implementation of this project are the HPUL Project Manager (PM), Quality Assurance Manager (QAM), and Task Leaders (TLs). Their duties are outlined briefly in this section. The project QAM is independent of the unit generating the data.

Rodney Williams is the HPUL PM and will provide senior-level oversight. The PM is responsible for HPUL's technical and financial performance as well as maintaining communications with the EPA to ensure mutual understanding of grant requirements, EPA expectations, and conformity with EPA quality procedures; managing oversight and conduct of project activities including allocation of resources to specific tasks; ensuring that quality procedures are incorporated into all aspects of the project; developing, conducting, and/or overseeing QA plans as necessary; ensuring that any corrective actions are implemented; operating project activities within the documented and approved QAPP; and ensuring all products delivered to the EPA are of specified type, quantity, and quality.

The HPUL PM will assign a Grantee TL (Daniella Cazares) for coordination of the various technical tasks with instructions to complete a baseline emissions inventory for the sector(s) under the task, to develop options for potential emissions reductions with estimated reductions per option, and to develop uncertainty estimates for each option's reduction estimate. In her role as Grantee Task Leader, Daniella Cazares will primarily be responsible for collecting and disseminating information to facilitate development of the GHG inventory and PCAP. Data reduction, analysis, GHG Inventory preparation, and PCAP development will be performed by Mike Riley (Technical Task Leader for Tasks 1 – 4) **Table 1.1** presents the TLs for each technical task. The Technical Task Leader (Mike Riley, Tasks 1-4) will coordinate with the Grantee Task Leader (Daniella Cazares) who will be responsible for gathering information that the Task 1-4 Task Leader will use to prepare project deliverables. Each TL is responsible for the day-to-day technical activities under their assigned task, including planning, reporting, and controlling of technical and financial resources allocated to the task by the PM. Accordingly, each TL is primarily responsible for implementing the Quality Program and this QAPP on task-level assignments.

*Task-level management system.* For each task's major deliverables, the assigned TL will review all QA-related plans and reports and is responsible for transmitting them to the QA Manager (or delegate) for review and approval. The TL is responsible for ensuring quality procedures are implemented at the task level and for maintaining the official, approved, task-level QAPP content. The TL will discuss any concerns about quality or any proposed revisions to task-level QAPP content with the PM, QAM, or delegate to identify, resolve, or preclude problems or to amend task-level plans, if necessary. In addition, each TL will work with the PM and the QAM to identify and implement quality improvements. The PM is responsible for ensuring the consistency of similar or related QA measures across tasks, and the TLs are responsible for overseeing task-level work performed by technical staff and providing assurance that all required QA/QC procedures are being implemented.

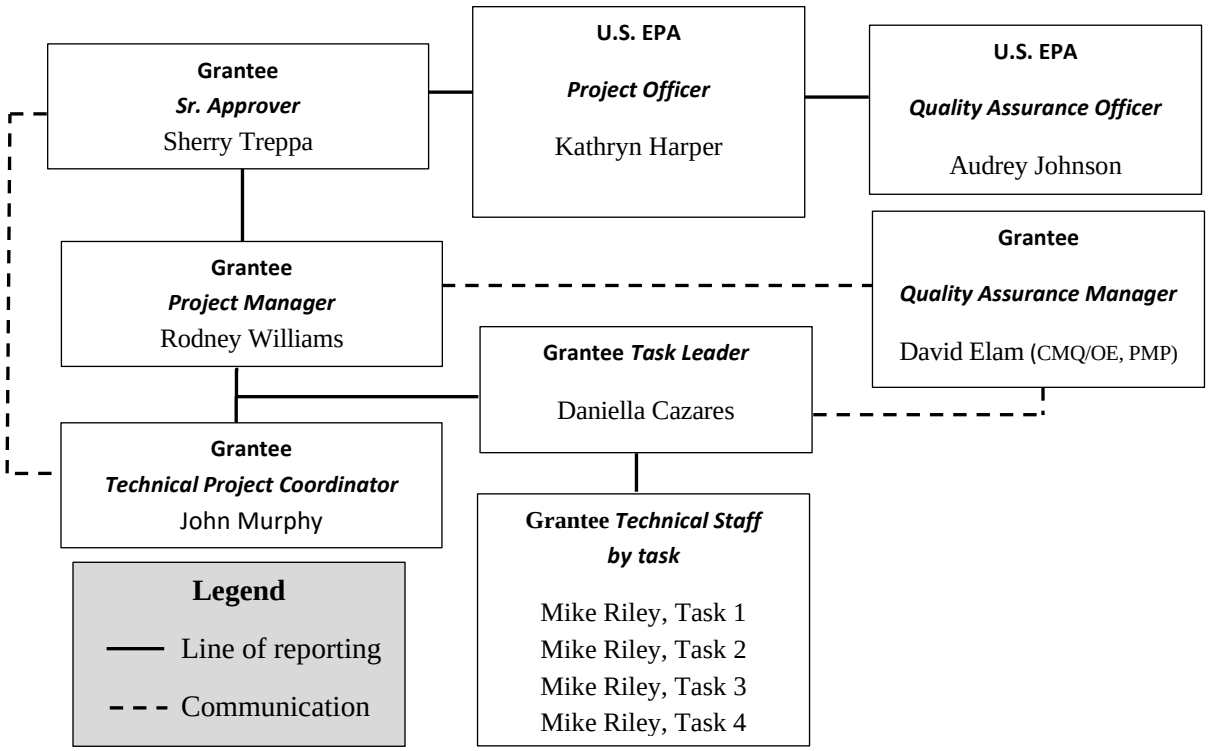
*Project-level management system.* Tasks are expected to proceed concurrently, in parallel. The PM will maintain close communications with each TL and ensure any difficulties encountered or proposed changes at the task level are reviewed for implications on other similar or related tasks. The PM is also responsible for communicating progress or difficulties encountered (across all tasks) to the EPA PO or POR, who provides the EPA's primary oversight function for this project at EPA OAR/ EPA Region 9 and is responsible for review and approval of this QAPP and any future revisions. The PM (with support from TLs and assigned HPUL technical staff) will be responsible for consulting with the EPA PO or POR, on planning, scheduling, and implementing the QA/QC for all project deliverables and obtaining required EPA approvals.

The QA Manager, David Elam (TRC), is responsible for overseeing the quality system, monitoring and facilitating QA activities on tasks, and generally helping the HPUL PM and TLs understand and comply with EPA QA requirements. The HPUL QAM will not be involved in data collection or analyses, which will be performed by the Task Leader and Technical Staff. At the request of the HPUL PM, Mr. David Elam is responsible for conducting periodic independent audits of this project's QA program, Mr. David Elam will produce written documentation of the audit results and recommendations.

John Murphy (CastleRock) will serve the Technical Project Coordinator available to assist with tasks related to the deployment of technology associated with the PCAP. He will report to the Project Grantee Project Manager but will have an open line of communication directly with the Grantee Sr. Approver.

In addition, QC functions will be carried out by other technical staff and will be carefully monitored by the PM, who will work with the QA Manager to oversee this plan and implement quality improvements. For work done under this project, technical staff may include persons with expertise in the tribe's residential, commercial, and industrial activities. Technical staff may also include persons with expertise in air pollution engineering, technical reviewers, database specialists, quality auditors, and technical editors. The PM will ensure that technical staff do not review work in a QA capacity for which they were a primary or contributing author. **Exhibit 1** presents the organizational chart for the project.

**Exhibit 1.** Project Organization[3]




[3] Under CIO 2105-S-02.0, section 3, the organization chart must also identify any contractor relationships relevant to environmental information operations.

## 1.5. Problem Definition / Background

Under this project, HPUL will identify, evaluate, and utilize existing data resources[4] to develop a tribal inventory of the major sources of greenhouse gas (GHG) emissions within HPUL Tribal Land and from planned offsite Tribal Operations and use that inventory data to develop a climate action plan. This QAPP focuses on the handling of environmental information under sector-specific tasks by technical staff charged with completing the following subtasks in a future planning project implemented in accordance with this QAPP:

1. Develop a comprehensive GHG inventory for the largest sources within each sector,
2. Develop options for reducing emissions within each sector,
3. Develop estimates or ranges of estimates for reductions achievable under each option,
4. Develop uncertainty analyses for each option's emissions reduction estimate, and
5. Present these analyses and options in technical reports consistent with the deliverables required under the CPRG planning grants.

The GHG inventory will utilize the EPA's Tribal – GHG Inventory Tool (TGIT),[5] facility-specific GHG data published by the EPA in the Facility Level Information on Greenhouse gases Tool (FLIGHT),[6] data reported to the EPA's Greenhouse Gas Reporting Program (GHGRP),[7] EPA's National Emissions Inventory (NEI),[8] DOE's State and Local Planning for Energy (SLOPE) Platform,[9] the Global Protocol for Community-Scale (GPC) Greenhouse Gas Inventories,[10] government operations protocols,[11] and/or 3rd party engineering repots, data or tools, together with any independent, sector-specific estimates prepared by HPUL. Any independent tribal estimates will be compared to corresponding federal, state, and/or local estimates for validation, as available. Significant differences between tribal and federal, state, or local estimates will be evaluated and discussed in the inventory report with the underlying data and methodology used for the independent tribal estimates. The tribal inventory will include the following source categories and gases:

| ***TGIT Source Categories*** | ***Greenhouse Gases (across all sectors)*** |
|---|---|
| 1. Mobile combustion<br>2. Stationary combustion<br>3. Electricity consumption<br>4. Solid waste<br>5. Urban forestry<br>6. Agriculture & land management<br>7. Water use<br>8. Waste generation<br>9. Wastewater treatment | carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), fluorinated gases (F-gases) including hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride ($SF_6$) |

[4] EPA, *Environmental Information Quality Policy*, CIO 2105.3, 03/07/2023 (p. 8) provides common examples of environmental information used to support the EPA's mission at https://www.epa.gov/system/files/documents/2023-04/environmental_information_quality_policy.pdf.
[5] https://www.epa.gov/statelocalenergy/tribal-greenhouse-gas-inventory-tool
[6] Facility Level Information on Greenhouse gases Tool (FLIGHT) at https://ghgdata.epa.gov/
[7] https://www.epa.gov/ghgreporting/data-sets
[8] https://www.epa.gov/air-emissions-inventories/national-emissions-inventory-ne
[9] https://www.energy.gov/scep/slsc/state-and-local-planning-energy-slope-platform
[10] https://ghgprotocol.org/ghg-protocol-cities
[11] https://ww2.arb.ca.gov/sites/default/files/classic/cc/protocols/lgo_protocol_v1_1_2010-05-03.pdf

### 1.5.1. Rationale for Selection of Sectors

For each sector included in the tribal inventory, **Table 1.2** briefly describes why the sector was included in the inventory and the relative significance of the sector in terms of the magnitude of air emissions from existing inventories, the associated geographic distribution of the sources, and recent trends in readily available activity data for the source category. HPUL has reviewed the TGIT and the rationale for including the indicated sectors in GHG Inventory. HPUL has determined that the TGIT will support the GHG emissions inventory development needs of HPUL. Further, HPUL believes that the rationale is generally applicable to HPUL and has offered a preliminary description of the sectors with respect to HPUL operations and a preliminary assessment of the relative magnitude of the sector emission on HPUL land.

**Table 1.2** Rationale for Sector Selection

| **Sectors Included in Inventory** | **Rationale for Including in GHG Inventory** |
|---|---|
| Mobile combustion | Transportation activities were the largest source (29 percent) of total U.S. greenhouse gas emissions in 2021. From 1990 to 2021, transportation $CO_2$ emissions from fossil fuel combustion increased by 19 percent. Transportation activities occur on all tribal lands. Mobile sources are expected to be an important component of the HPUL GHG inventory due to automobile traffic to and from the casino and other Tribal Facilities. |
| Electricity consumption | The electric power sector accounted for 25 percent of total U.S. greenhouse gas emissions in 2021. Power generation and/or consumption occurs among all tribes. Power consumption is also expected to be an important component of the HPUL GHG inventory because of casino and support operations on HPUL land. |
| Urban forestry[12] | This sector includes fluxes of carbon from activities such as converting forests to agricultural use and practices that remove $CO_2$ from the atmosphere and store it in long-term carbon sinks like forests. In 2021, the net $CO_2$ removed from the atmosphere by natural and working lands was 12% of total U.S. greenhouse gas emissions. Between 1990 and 2021, total carbon sequestration in this sector decreased by 14%, primarily due to a decrease in the rate of net carbon accumulation in forests, as well as an increase in $CO_2$ emissions from urbanization. HPUL operations are located on approximately 180 acres. A portion of that property may meet the definition of urban forest. Accordingly, HPUL anticipates this will be a minor component of the HPUL GHG inventory. Although minor, HPUL believes this is an important category to understand given plans to acquire additional property and manage it as carbon sinks. |
| Agriculture & land management | Agriculture accounted for about 10 percent of U.S. greenhouse gas emissions in 2021, and agricultural soil management was the largest source of $N_2O$ emissions. Enteric fermentation was the largest source of $CH_4$ emissions. Agricultural operations on HPUL land are limited to small produce and herb gardens; however, open areas are managed and maintained using commercial landscaping practices. |

[12] Under international GHG inventory protocols this category is called “Land use, land-use change, and forestry.”

**Table 1.2** Rationale for Sector Selection

| **Sectors Included in Inventory** | **Rationale for Including in GHG Inventory** |
|---|---|
| | Again, HPUL anticipates the GHG emissions associated with agricultural and land management operation will be minor. |
| Stationary combustion (including for commercial and residential heating) | In 2021, the commercial and residential sectors accounted for 7 and 6 percent of total U.S. greenhouse gas emissions, respectively. Emissions from the commercial and residential sectors have increased since 1990. Total residential and commercial greenhouse gas emissions, including direct and indirect emissions, in 2021 have increased by 2% since 1990. In 2021, an increase in heating degree days (0.5 percent) increased energy demand for heating in the residential and commercial sectors, however, a 1.8 percent decrease in cooling degree days compared to 2020 reduced demand for air conditioning in the residential and commercial sectors. HPUL combusts fossil fuels including gasoline, diesel fuel, and propane to heat buildings, power automobiles and for standby power generation. HPUL anticipates that GHG emissions from stationary combustion will be moderate. |
| Solid waste and waste generation | This sector includes landfills, composting, and anaerobic digestion. Landfills were the third largest source of anthropogenic methane emissions in 2021, and landfills accounted for 1.9 percent of total U.S. greenhouse gas emissions. HPUL does not operate a solid waste treatment facility but uses a third party to transport solid waste offsite for disposal. HPUL anticipates that solid waste generation will be a moderate source of GHG emissions but may represent an area for GHG reduction with improved materials sourcing and recycling. |
| Wastewater treatment | Wastewater treatment, both domestic and industrial, was the third largest anthropogenic source of $N_2O$ emissions in 2021, accounting for 5.2 percent of national $N_2O$ emissions and 0.3 percent of total U.S. greenhouse gas emissions. Emissions from wastewater treatment increased by 6.1 MMT $CO_2e$ (41.6 percent) since 1990 as a result of growing U.S. population and protein consumption. HPUL does not operate a wastewater treatment facility but relies on the services of publicly owned treatment works (POTW) for wastewater treatment. HPUL anticipates that wastewater generation will be a moderate source of GHG emissions for HPUL but may represent an area for GHG reduction through improved water conservation. |
| Water | This sector includes indirect emissions associated with the electricity used to deliver water to tribal lands. HPUL operates a water well and water distribution network for its local Tribal reservation area. As a result, HPUL GHG emissions calculations for water treatment will include more than electricity. |

### 1.5.2. Decisions to be Made

The EPA's recommended tool for tribal GHG inventories (the TGIT) covers categories of GHG emissions by source category (mobile combustion, stationary combustion, electricity consumption, solid waste, etc.). The TGIT provides many default values to facilitate developing tribal estimates using

methods consistent with the Global Protocol for Community-Scale GHG Emissions.[13] The primary decisions to be made on this project will determine (for each source category) if the TGIT estimate or a non-federal estimate should be used for the tribal GHG inventory. For some source categories, alternatives to the TGIT estimates may include existing data resources from the EPA, tribal inventories, and GHGRP data publications. There are four primary decisions to be made under each task of this project for each source category. Each Task Leader will be charged with the following decisions:

1. Determine (for each major activity) if the TGIT estimate, a different federal estimate or tool, or a non-federal estimate should be used for the tribal GHG baseline estimate.
2. Determining the best options for reducing emissions of air pollution and achieving the following congressional objectives under the Inflation Reduction Act:
    a. Reduce climate pollution while supporting creation of good jobs and lowering energy costs for families.
    b. Accelerate work addressing environmental justice and empowering community driven solutions in overburdened neighborhoods.
    c. Deliver cleaner air by reducing harmful air pollution in places where people live, work, play, and go to school.
3. Develop an estimate or a range of estimates for reductions achievable under each option.
4. Estimate the uncertainty of the emissions reduction estimate(s) or ranges under each option.

### 1.5.3. Actions to be Taken, Action Limits, and Expected Outcomes

Initially, tribal estimates will be derived using the TGIT tool for each source category. Subsequently, the tribe may elect to supplement estimates derived with the TGIT with estimates for each source category from existing tribal inventories, existing tribal activity data, or from other EPA or state resources. Calculated estimates derived from local activity data will be compared to federal datasets and/or downscaled state estimates for validation. The rationale for including any emissions estimates that show significant discrepancies from state or federal estimates will be documented in the Tribe's GHG inventory report along with the underlying data and calculation methodology.

When identifying the best options for reducing air pollution, each Task Leader will consider the activities affecting the largest numbers of families, business establishments, recreation areas, and schools. Options will include potential reductions in task-level activities impacting residential, commercial, and school districts in close proximity to the largest sources of air pollution. HPUL expects that each task will produce 3-5 options for sector-specific emissions reduction projects for further consideration by management and policymakers.

### 1.5.4. Reason for Project

The baseline GHG inventory and options analyses developed under this tribal community project will be utilized by HPUL and EPA Region 9 for planning purposes to support HPUL's development of the following CPRG planning deliverables:

- HPUL's **Priority Climate Action Plan** (PCAP), which is due on April 1, 2024. This plan will include near-term, implementation-ready, priority GHG reduction measures and is a prerequisite for any implementation grant. Specifically, the HPUL PCAP will include:
    - Simplified GHG Inventory
    - Quantified High Priority GHG Reduction Measures
    - Benefits Analysis
    - Review of Authority to Implement

[13] https://ghgprotocol.org/sites/default/files/standards/GPC_Full_MASTER_RW_v7.pdf

- Intersection with Other Funding Availability (not required but HPUL plans to include)
- Workforce Planning Analysis (not required but HPUL plans to include)

- HPUL's **Comprehensive Climate Action Plan** (CCAP) is due at the end of the grant period which can be up to 4 years.[14] This plan will review all sectors that are significant GHG sources or sinks and include both near- and long-term GHG emission reduction goals and strategies. Specifically, the HPUL CCAP will include:
  - Comprehensive GHG Inventory
  - Near- and Long-term GHG Emissions Projections
  - Comprehensive, Quantified GHG Reduction Measures
  - Benefits Analysis
  - Review of Authority to Implement
  - Intersection with Other Funding Availability
  - Workforce Planning Analysis

This QAPP describes in detail the necessary QA and QC requirements and technical activities that will be implemented to ensure the baseline GHG inventory and the sector-specific emissions reduction options are reliable for the PCAP and CCAP.

### 1.5.5. Relevant Clean Air Act Mandates and Authorizations

The inventory produced under this project will support a grant application authorized under 42 U.S.C.A. § 7437 for *Greenhouse Gas Air Pollution Plans and Implementation Grants*. The inventory will be used to evaluate opportunities for reducing GHG emissions from all major-emitting sources including both mobile source categories and stationary source categories. This project will include the fundamental research necessary to evaluate and plan new programs (and amendments to existing Clean Air Act [CAA] programs) for reducing emissions from fossil fuel combustion activities. Many activities in the GHG inventory (and subsequent emissions reductions options analyses) include major sources of criteria and toxic pollutants. Accordingly, the purpose of this project (to evaluate and plan for reductions in GHG emissions, including reductions from usage or production of fossil fuels) is also consistent with the following statutory mandates and authorizations under Clean Air Act Title I:

- ***§ 7403. Research, investigation, training, and other activities***
  *(a) Research and development program for prevention and control of air pollution*
  *The Administrator shall establish a national research and development program for the prevention and control of air pollution ….*
  *(1) conduct, and promote the coordination and acceleration of, research, investigations … and studies related to the causes … extent, prevention, and control of air pollution;*
  *(2) encourage, cooperate with, and render technical services and provide financial assistance to air pollution control agencies and other appropriate public or private agencies, institutions, and organizations, and individuals in the conduct of such activities ….*
  *(b) Authorized activities of Administrator in establishing research and development program*
  *In carrying out the provisions of* [paragraph (a)] the Administrator is authorized to–

[14] US Environmental Protection Agency. *CPRG Program: Formula Grants for Planning – Program Guidance for Federally Recognized Tribes, Tribal Consortia, and U.S. Territories* available via https://www.epa.gov/inflation-reduction-act/climate-pollution-reduction-grants#CPRGProgramGuidance. Accessed 7/23/2023.

*(1) collect and make available, through publications and other appropriate means, the results of and other information, including appropriate recommendations by him in connection therewith, pertaining to such research and other activities;*
*(2) make grants to air pollution control agencies … for purposes … in subsection (a)(1) ….*

- ***§ 7404. Research related to fuels and vehicles***
  *(a) Research programs; grants; ….*
  *The Administrator shall give special emphasis to research and development into new and improved methods, having industry-wide application, for the prevention and control of air pollution and control of air pollution resulting from the combustion of fuels… he shall–*
  *(1) conduct and accelerate research programs directed toward development of improved , cost-effective techniques for–*
  *(A) control of combustion byproducts of fuels, ….*
  *(B) improving efficiency of fuels combustion so as to decrease atmospheric emissions ….*

- ***§ 7405. Grants for support of air pollution planning and control programs***
  *(a) Amounts; limitations; assurances of plan development capability.*
  *(1)(A) The Administrator may make grants to air pollution control agencies … in an amount up to three-fifths of the cost of implementing programs for the prevention and control of air pollution …. For the purpose of this section, "implementing" means any activity related to the planning, developing, establishing, carrying-out, improving, or maintaining of such programs….*
  *(C) With respect to any air quality control region or portion thereof for which there is an applicable implementation plan under section 7410 … grants under subparagraph (A) may be made only to air pollution control agencies which have substantial responsibilities for carrying out such applicable implementation plan.*

### 1.5.6. Information Provided by the EPA under § 7403(b)(1)

Under authority of CAA § 7403(b)(1) the EPA has provided the following resources to tribes to ensure reliable air emissions inventories are produced to support plans for reducing emissions:

- Agency-wide Quality Program Documents
- Quality Assurance-specific Directives
  - CIO 2105.3 – *Environmental Information Quality Policy*, April 10, 2023
  - CIO 2105-P-01.3 – *Environmental Information Quality Procedure*, March 7, 2023
  - CIO 2105-S-02.0 – *EPA's Environmental Information QA Project Plan Standard*
  - EPA Regional 9 Site for Quality Management Plans and Guidance:
- QA Guidance
  - EPA QA/G-4 – *Guidance on Systematic Planning Using Data Quality Objectives Process*
  - EPA QA/G-5 – *Guidance for Quality Assurance Project Plans*

HPUL will utilize these resources, as applicable, to ensure evaluation of existing data and utilization of those data are consistent with the EPA's relevant directives and guidance.

## 1.6. Project / Task Description

An example schedule of deliverables for the technical tasks (Tasks 1-4) for GHG inventory QAPPs is presented in **Tables 2.1** through **2.4.** The work to be performed under this project involves preparing a tribal GHG emissions inventory for HPUL. The organization of the work is based on the use of the EPA's Tribal – GHG Inventory Tool (TGIT)[15] under the following sector-specific tasks:

Task 1: Tribal inventory of mobile combustion GHG emissions.

Task 2: Tribal inventory of electric power consumption (indirect) GHG emissions.

Task 3: Tribal inventory of GHG emissions and sinks from urban forestry.

Task 4: Tribal inventory of GHG emissions from other sectors.

- 4.1 Stationary combustion
- 4.2 Agriculture and land management
- 4.3 Waste generation
- 4.4 Solid waste
- 4.5 Water
- 4.6 Wastewater treatment

For each sector-specific task, **Tables 2.1–2.4** provide planned activities and a schedule of deliverables for use by tribes preparing GHG inventories. The EPA's TGIT is available on EPA's Tribal GHG Inventory Tool webpage. Other resources, are located on the State and Tribal Greenhouse Gas Data and Resources webpage.[16]

**Table 2.1** Technical Task Descriptions for Task 1.

| Tasks and Deliverables | Schedule |
|---|---|
| **Task 1. Mobile Combustion (Transportation)** | |
| 1. The PM or TL will assign staff to download the EPA's Tribal – GHG Inventory Tool (TGIT) from https://www.epa.gov/statelocalenergy/tribal-greenhouse-gas-inventory-tool and use that tool to estimate emissions from mobile combustion sources. | Within 3 days of QAPP approval by EPA. |
| 2. Staff will read the [Introduction] worksheet and the [Read Me] worksheet to become familiar with the organization of the tool and the tool's terminology. Staff will become familiar with Rows 42 through 59 of the [Read Me] sheet that reflect a brief summary of the steps necessary to complete the calculations for each sector. Additionally, staff can reference the TGIT User's Guide for the Community Module that is included within the downloaded zip file. | Within 5 days of QAPP approval by EPA. |
| 3. Staff will complete the four initial setup steps on the [Control Sheet]. | Within 5 days of |

[15] https://www.epa.gov/statelocalenergy/tribal-greenhouse-gas-inventory-tool .
[16] https://www.epa.gov/ghgemissions/state-and-tribal-greenhouse-gas-data-and-resources.

**Table 2.1** Technical Task Descriptions for Task 1.

| Tasks and Deliverables | Schedule |
|---|---|
| **Task 1. Mobile Combustion (Transportation)** | |
| | QAPP approval by EPA. |
| 4. Staff will review chapter 7 on transportation in the Global Protocol for Community-Scale GHG Emissions [available at Protocol for Community-Scale Inventories]. | Within 5 days of QAPP approval by EPA. |
| **5.** Staff will obtain from a state or tribal motor vehicle agency, the most recent listing of vehicles registered at addresses located on tribal lands including (as available) year-manufactured, make, model, body style, fuel, and description. **Staff will request this information upon submittal of the QAPP so that the info is available upon EPA approval of the QAPP.** | Within 5 days of QAPP approval by EPA. |
| 6. In the TGIT: Community Module [tribal_community_ghg_inventorytool.xlsm], staff will use the [Mobile-Entry] sheet to load the tribe's population of fossil-fueled motor vehicles. Staff will prepare an aggregated listing (i.e., listing of sets of vehicles with counts by vehicle type, model, year, and fuel) for all of the tribe's vehicles and an estimate of the average fuel consumed for each set of similar vehicles. | Within 5 days of QAPP approval by EPA. |
| 7. After the primary TGIT calculations are complete, the PM, TL, or QAM will assign a QC staff member to complete the following steps:<br>a. Review the original source(s) of data for all inputs to the TGIT tool.<br>b. Validate that the values from the original source(s) were correctly entered into the primary TGIT tool.<br>c. Populate a blank version of the TGIT tool with the inputs in a QC version.<br>d. Compare the outputs of the primary version of the TGIT versus the QC version of the TGIT.<br>e. Compare the listing of sources on the TGIT's [Summary-Emissions] sheet to previous inventories published by the tribe or by neighboring or similar tribes to determine if any major sources of GHGs were omitted from the inventory.<br>f. Document findings and submit to the PM, TL, and QAM for resolution.<br>g. Document steps taken to resolve any findings. | Within 15 days of TGIT calculation completion. |

**Table 2.1** Technical Task Descriptions for Task 1.

| Tasks and Deliverables | Schedule |
|---|---|
| **Task 1. Mobile Combustion (Transportation)** | |
| 8. In the GHG inventory report or in a separate report based on the GHG inventory, include a listing of options for emissions reductions from this sector that includes the following components:<br>a. The specific source categories and activities affected by the proposed option.<br>b. The quantity of GHG emissions reduced by the options with an associated uncertainty estimate.<br>c. The quantity of criteria emissions reduced by the options with an associated uncertainty estimate.<br>d. The quantity of toxic air pollutant emissions (as defined under applicable local, state, or federal rules for air toxics) reduced by the option with an associated uncertainty estimate.<br>e. Number of people living in any nonattainment areas where option would reduce emissions (regardless of pollutant triggering nonattainment).<br>f. A description of any benefits that the option will impart to communities with known environmental injustice issues such as close proximity of the community to an affected source under the option that emits toxic air pollutants. | Within 30 days of completion of Task 1, Step 7.<br><br>. |

**Table 2.2** Technical Task Descriptions for Task 2.

| Tasks and Deliverables | Schedule |
|---|---|
| **Task 2. Electric Power Consumption** | |
| 1. The PM or TL will assign a staff member to use the EPA's TGIT tool [tribal_community_ghg_inventorytool.xlsm] and to verify that the four initial steps required on the [Control Sheet] have been completed. | Within 3 days of QAPP approval by EPA. |
| **2.** Staff will obtain records regarding power consumption. **Staff will request this information upon submittal of the QAPP so that the info is available upon EPA approval of the QAPP.** | Within 5 days of QAPP approval by EPA. |

**Table 2.2** Technical Task Descriptions for Task 2.

<table>
<tr><th>Tasks and Deliverables</th><th>Schedule</th></tr>
<tr><td colspan="2">Task 2. Electric Power Consumption</td></tr>
<tr><td>3. Staff will use the [Electricity-Entry] sheet of the EPA's TGIT tool. Staff will read the explanation of the Data Entry & Calculations starting in cell A3. Staff will enter the data such that each entry represents either a single, large tribal facility (e.g., a commercial or institutional facility) or a set of similar facilities (e.g., a group of similar residential units).<br><br>For groups of similar units, when entering the Unit Description in cell C10 of the [Electricity-Entry] sheet, staff will include in the description the number of units that were included when the electricity purchased (kWh) value was summed or otherwise calculated for entry into cell C16.<br><br>Staff will document each calculation with units of measure for each record added on the [Electricity-Entry] sheet in a manner similar to the following example, including the source[17] of the MW-hr usage per unit (i.e., per customer) entered in column C:<br><br>
<table>
<tr><th>A</th><th>B</th><th>C</th><th></th><th>D</th></tr>
<tr><td>Count of Units in Set</td><td>Set Description</td><td>Avg. Annual kWh Used (per Unit)</td><td></td><td>Annual Usage (All Units)</td></tr>
<tr><td>1000</td><td>Single-family home</td><td>750 kWh<br>(Single-family home) (1 Year)</td><td>=</td><td>750,000 kWh<br>Year</td></tr>
</table>
<br>4. After the primary TGIT calculations are complete, the PM, TL or QAM will assign a QC staff member to complete the following steps:<br>a. Review the original source(s) of data for all inputs to the TGIT tool.<br>b. Validate that the values from the original source(s) were correctly entered into the primary TGIT tool.<br>c. Populate a blank version of the TGIT tool with the inputs in a QC version.<br>d. Compare the outputs of the primary version of the TGIT versus the QC version of the TGIT.<br>e. Compare the listing of sources on the TGIT's [Summary-Emissions] sheet to previous inventories published by the tribe or by neighboring or similar tribes to determine if any major sources of GHGs were omitted from the inventory.<br>f. Document findings and submit findings to the PM, TL, and QAM for resolution.<br>g. Document steps taken to resolve any findings.</td><td>Within 5 days of QAPP approval by EPA.<br><br>Within 15 days of TGIT calculation completion.</td></tr>
</table>

[17] ***Attachment 1*** *to this template presents an excerpt from the EIA Form 861 file entitled [Sales_Ult_Cust_2020.xlsx] showing the number of customers and usage (MW-hrs) for some tribes that report to EIA Form 861. Tribes may elect to compare their usage per customer to other tribes in the QC step.*

**Table 2.2** Technical Task Descriptions for Task 2.

| Tasks and Deliverables | Schedule |
|---|---|
| **Task 2. Electric Power Consumption** | |
| 5. In the GHG inventory report or in a separate report based on the GHG inventory, include a listing of options for emissions reductions from this sector that includes the following components:<br>a. The specific source categories and activities affected by the proposed option.<br>b. The quantity of GHG emissions reduced by the options with an associated uncertainty estimate.<br>c. The quantity of criteria emissions reduced by the options with an associated uncertainty estimate.<br>d. The quantity of toxic air pollutant emissions (as defined under applicable local, state, or federal rules for air toxics) reduced by the option with an associated uncertainty estimate.<br>e. The number of people living in any nonattainment areas where the option would reduce emissions (regardless of the specific pollutant triggering nonattainment).<br>f. A description of any benefits that the option will impart to communities with known environmental injustice issues such as close proximity of the community to an affected source under the option that emits toxic air pollutants. | Within 30 days of completion of Task 2, Step 4. |

**Table 2.3** Technical Task Descriptions for Task 3.

| Tasks and Deliverables | Schedule |
|---|---|
| **Task 3. Urban Forestry (Natural Working Lands and Forestry)** | |
| 1. The PM or TL will assign technical staff to develop estimates for this sector using the TGIT's [Urban_Forestry] worksheet. | Within 3 days of QAPP approval by EPA. |
| **2. Staff will obtain a plot plan of the HPUL property showing buildings, forested areas, non-paved open areas, roadways, and parking areas. Staff will request this information upon submittal of the QAPP so that the info is available upon EPA approval of the QAPP.** | Within 3 days of QAPP approval by EPA. |

**Table 2.3** Technical Task Descriptions for Task 3.

| Tasks and Deliverables | Schedule |
|---|---|
| **Task 3. Urban Forestry (Natural Working Lands and Forestry)** | |
| 3. In order to estimate the areas of land with similar percentages of tree cover, staff will use a web-based mapping application to develop a listing of tree-covered tracts of land (i.e., polygons) with the following attributes:<br>a. Identifier describing area.<br>b. Sector (residential, commercial/institutional, industrial, energy generation).<br>c. Total area in square kilometers ($km^2$).<br>d. Percentage of area with tree cover based on tribal estimate. | Within 5 days of QAPP approval by EPA. |
| 4. For each sector, staff will calculate weighted percentage tree cover using **Equation 1.**<br><br>**Equation 1** for weighted percentage of tree cover for a sector:<br><br>$$\frac{\sum_{i=1}^{i=30}(km^2\ of\ area\ i)(\%\ tree\ cover\ of\ area\ i)}{\sum_{i=1}^{i=30}(km^2\ i)}$$<br><br>Where:<br>$i$ = 1 to 30 — Designates 30 tree-covered areas in a sector on tribal lands.<br>$km^2$ of area $i$ — The measured area (in square kilometers) of area $i$.<br>% tree cover of area $i$ — The estimated percentage of tree cover for area $i$.<br>$\sum_{i=1}^{i=30}(km^2\ i)$ — The denominator is the total combined area of all 30 areas within the sector. | Within 10 days of QAPP approval by EPA. |
| 5. For each sector on the TGIT's [Urban Forestry] worksheet staff will enter total area for the sector in column C rows 11 through 14 and enter weighted % tree cover in Column D. | Within 10 days of QAPP approval by EPA. |
| 6. For the two sectors with the largest areas of tree cover, the QAM will assign a QC staff member who did not support steps 1 through 4, to develop independent estimates and to complete the following QC steps:<br>a. Review the original source(s) of data for all inputs to the primary TGIT tool.<br>b. Validate correct entry of values from original source(s) into the primary TGIT.<br>c. Populate a blank version of the TGIT tool with the inputs in a QC version.<br>d. Compare the primary outputs of the TGIT versus the QC version of the TGIT. | Within 5 days of completion of Task 3, Step 5. |

**Table 2.3** Technical Task Descriptions for Task 3.

| Tasks and Deliverables | Schedule |
|---|---|
| **Task 3. Urban Forestry (Natural Working Lands and Forestry)** | |
| e. Compare the listing of resources on the TGIT's [Summary-Emissions] sheet to previous inventories published by the tribe or by neighboring or similar tribes to identify any major discrepancies.<br>f. Document findings and submit findings to the PM, TL, and QAM for resolution.<br>g. Document steps taken to resolve any findings. | |
| 7. In the inventory report or in a separate report based on the inventory, include a listing of options for emissions reductions from this sector that includes the following components:<br>a. Specific source categories and activities affected by the proposed option.<br>b. Quantity of GHG emissions reduced by option with uncertainty estimate.<br>c. Quantity of criteria emissions reduced or mitigated (such as by adsorption of PM2.5 on leaf surfaces) by the option with an associated uncertainty estimate.<br>d. The number of people living in any nonattainment areas where the option would reduce emissions or improve air quality conditions by providing shade to urban heat islands (regardless of the specific pollutant triggering nonattainment).<br>e. A description of any benefits that the option will impart to communities with known environmental injustice issues such as providing windbreaks to communities in close proximity to sources of nuisance dust (e.g., dirt roads used for mining operations).<br>f. The number of schools, miles of roadways, or public traffic counts at major commuting destinations that would be positively affected by options that include planting of trees or other vegetation. | Within 30 days of completion of Task 3, Step 5. |

**Table 2.4** Technical Task Descriptions for Task 4.

| Tasks and Deliverables | Schedule |
|---|---|
| **Task 4. Tribal Inventory of GHG Emissions for Other Sources** | |
| **1.** The PM or TL will assign the primary technical staff member(s) to use the EPA's TGIT tool and the following worksheets to develop the primary estimates for other sectors. **Staff will request fossil fuel consumption, agricultural/landscape chemical usage, water consumption, wastewater treatment records, and solid waste disposal records upon submittal of the QAPP so that the info is available upon EPA approval of the QAPP.** | Within 3 days of QAPP approval by EPA. |
| 2. After the primary TGIT calculations are complete, the PM, TL or QAM will assign a QC staff member to complete the following steps:<br>a. Review the original source(s) of data for all inputs to the TGIT tool.<br>b. Validate that the values from the original source(s) were correctly entered into the primary TGIT tool.<br>c. Populate a blank version of the TGIT tool with the inputs in a QC version.<br>d. Compare the outputs of the primary version of the TGIT versus the QC version of the TGIT.<br>e. Compare the listing of sources on the TGIT's [Summary-Emissions] sheet to previous inventories published by the tribe or by neighboring or similar tribes to determine if any major sources of GHGs were omitted from the inventory.<br>f. Document findings and submit findings to the PM, TL and QAM for resolution.<br>g. Document steps taken to resolve any findings. | Within 15 days of TGIT calculation completion. |
| 3. In the GHG inventory report or in a separate report based on the GHG inventory, include a listing of options for emissions reductions from this sector that includes the following components:<br>a. The specific source categories and activities affected by the proposed option. | Within 30 days of completion of Task 4, |

| Other Sources | TGIT Worksheet(s) |
|---|---|
| Stationary combustion | [Stationary-Entry]<br>[Stationary-Data]<br>[Stationary-Calcs] |
| Agriculture & land management | [Agriculture & Land Management] |
| Solid waste (disposal within tribe's geopolitical boundary) | [Solid Waste-Control]<br>[Solid Waste-Entry] |
| Water | [Water] |
| Wastewater treatment | [Wastewater-Control]<br>[Wastewater-Entry]<br>[Wastewater-Calcs] |
| Waste generation (disposal external to tribe's geopolitical boundary) | [Waste Production] |

**Table 2.4** Technical Task Descriptions for Task 4.

| **Tasks and Deliverables** | **Schedule** |
|---|---|
| **Task 4. Tribal Inventory of GHG Emissions for Other Sources** | |
| b. The quantity of GHG emissions reduced by the options with an associated uncertainty estimate.<br>c. The quantity of criteria emissions reduced by the options with an associated uncertainty estimate.<br>d. The quantity of toxic air pollutant emissions (as defined under applicable local, state, or federal rules for air toxics) reduced by the option with an associated uncertainty estimate.<br>e. The number of people living in any nonattainment areas where the option would reduce emissions (regardless of the specific pollutant triggering nonattainment).<br>f. A description of any benefits that the option will impart to communities with known environmental injustice issues such as close proximity of the community to an affected source under the option that emits toxic air pollutants. | Step 2. |

## 1.7. Quality Objectives / Criteria

### 1.7.1. Data Quality Objectives

The primary objectives for this project are to develop reliable inventories for each of the GHG-emitting sectors for HPUL and to identify options for reducing emissions from those sectors. Accordingly, all quality objectives and criteria are aligned with these objectives. The quality system used for this project is the joint responsibility of the HPUL PM, Task Leaders, and QA Manager. An organizationally independent QA Manager will maintain oversight of all required measures in this QAPP. QC functions will be carried out by technical staff and will be carefully monitored by the responsible Task Leaders, who will work with the QA Manager to identify and implement quality improvements. All activities performed under this project will conform to this QAPP.

### 1.7.2. Data Quality, Management, and Analyses

For this project, HPUL will use a variety of QC techniques and criteria to ensure the quality of data and analyses. Data of known and documented quality are essential components for the success of the project, as these data will be used to inform the decision-making process for the PCAP and CCAP as discussed in Section 1.5.4. The table in **Appendix A** lists by task the specific QC techniques and criteria that are part of this QAPP.

The data quality objectives and criteria for this project are accuracy, precision, bias, completeness, representativeness, and comparability. *Accuracy* is a measure of the overall agreement of a measurement to a known value. It includes a combination of random error (precision) and systematic error (bias). *Precision* is a measure of how reproducible a measurement is or how close a calculated estimate is to the actual value. *Bias* is a systematic error in the method of measurement or calculation. If the calculated value is consistently high or consistently low, the value is said to be biased. Our goal is to ensure that information and data generated and collected are as accurate, precise, and unbiased as possible within project constraints. It is not anticipated that this project will include primary data collection. Generally, existing data and tools provided by the EPA and other qualified sources will be used for project tasks. A subject matter specialist familiar with technical reporting standards (such as a permit writer or compliance engineer with knowledge of the tribe's facilities operating in the sector) will be used to QA all data utilized for developing the tribal GHG inventory. HPUL will verify the accuracy of all data by checking for logical consistency among datasets. All existing environmental data shall meet the applicable criteria defined in CFR and associated guidance, such as the validation templates provided in the *EPA QA Handbook Volume II*.

Uncertainty can be evaluated using a few different approaches. The most useful uncertainty analysis is quantitative and is based on statistical characteristics of the data such as the variance and bias of estimates. In a sensitivity analysis, the effect of a single variable on the resulting emissions estimate generated by a model (or calculation) is evaluated by varying its value while holding all other variables constant. Sensitivity analyses will help focus on the data that have the greatest impact on the output data. Additional statistical tests may be utilized depending on the need for more or less rigorous tools and on the specific project activity being evaluated.

When available, data originally gathered using published methods whose applicability, sensitivity, accuracy, and precision have been fully assessed, such as EPA reference methods, will be preferred and considered to be of acceptable quality. Project decisions may be adversely impacted if, for example, existing data were used in a manner inconsistent with the originator's purpose. Metadata can be described as the amount and quality of information known about one or more facets of the data or a dataset. It can be used to summarize basic information about the data (e.g., how, why, and when the

existing data were collected), which can make working with specific data or datasets easier and provides the user with more confidence. Metadata are valuable when evaluating existing data, as well as when planning for collection primary data that may be required in the future. However, the effort needed to locate and obtain original source materials can be costly. Accordingly, a graded approach to planning will be applied and ongoing discussions with the EPA will be held to determine what magnitude and rigor of QA effort are appropriate and affordable for the project.

For the data analysis completed under this project, analytical methods will be reviewed to ensure the approach is appropriate and calculations are accurate. Spreadsheets will be used to store data and complete necessary analyses. Design of spreadsheets will be configured for the intended use. All data and methodologies specific to each analysis will be defined and documented. Tables and fields will be clearly and unambiguously named. Spreadsheets will be checked to ensure algorithms call data correctly and units of measure are internally consistent. Hand-entered or electronically transferred data will be checked to ensure the data are accurately transcribed and transferred.

The draft inventory will be evaluated for GHG-emitting-sector and geographic completeness. HPUL will utilize the framework of sectors in the EPA's TGIT tool, previous inventories completed by the tribe, or previous inventories completed by similar tribes to ensure that the inventory prepared under this project includes all major GHG-emitting sectors. To ensure the inventory is geographically complete, the draft inventory will also be submitted for review by HPUL staff within the tribe or are familiar with all tribal activities subject to tribal or federal standards issued under Title I of the CAA to ensure that all major-emitting activities on tribal lands are included in the inventory.

*Representativeness* is a qualitative term that expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. HPUL will use the most complete and accurate information available to compile representative data for the tribe's GHG-emitting activities.

Data *comparability* is a qualitative term that expresses the measure of confidence that one dataset can be compared to another and can be combined for the decision(s) to be made. HPUL will compare datasets when available from different sources to check for the quality of the data. This QA step will also ensure that any highly correlated datasets or indicators are identified. Supporting data, such as information on reference methods used and complete test reports, are important to ensure the comparability of emissions data.

### 1.7.3. Document Preparation

All documents produced under this project will undergo internal QC review, as well as technical review and an editorial review, prior to submission to the EPA PO. QC will be performed by an engineer, scientist, or economist, as appropriate, with sufficient knowledge. The technical reviewer will review the document for accuracy and integrity of the technical methodologies, analyses, and conclusions.

An editorial review of all final documents will be performed. Editors will verify clarity, spelling, and grammatical correctness, and ensure documents are free of typographical errors. Editors will verify that references are cited correctly. This will include a comparison against the original documents.

The *QC Documentation Form* (**Appendix B**) will be used to track the approval process. The form must be completed and signed for all document deliverables. The signatures required include those of the Task Leader and technical and editorial reviewers. Completion of this form certifies that technical review, editorial review, and all required QC procedures have been completed to the satisfaction of the TL and QA Manager. Copies of these signed forms will be maintained in the project files.

## 1.8. Special Training / Certifications

All HPUL staff assigned to work on this project shall have appropriate technical and QA training to properly perform their assignments. HPUL staff serving in the QAM role under this project will hold credentials as a Certified Manager of Quality/Organizational Excellence from the American Society for Quality and have completed a training course the EPA course on QA/QC activities similar to the course available at https://www.epa.gov/quality/training-courses-quality-assurance-and-quality-control-activities. The PM and all TLs under this project will have completed an online training course on air emissions inventories on the Air Knowledge website at https://airknowledge.gov/EMIS-SI.html. Such training will be completed while EPA is reviewing the QAPP. No additional technical training is required.

If training is required for new staff or for particular segments of the GHG inventory, the PM in coordination with the associated TL will identify available training resources for the inventory segment and incorporate the required training into the project schedule.

## 1.9. Documents and Records

HPUL will document in electronic form (and/or hard copy) QC activities for this project. The TL is responsible for ensuring that copies of all completed QC forms, along with other QA records (including this QAPP), will be maintained in the project files. Project files will be retained by HPUL for10 years from the date of grant completion (10 years is the standard HPUL record retention policy). The types of documentation that will be prepared for this project include:

- Planning documentation (e.g., QAPP)
- Implementation documentation (i.e., Review/Approval Forms, Work Instructions or Standard Operating Procedures, and QC records)
- Assessment documentation (i.e., audit reports and independent calculations).

Detailed documentation of QC activities for a specific task or subtask will be maintained using the *QC Documentation Form* shown in **Appendix B**. This form will document the completion of the QC techniques planned for use on this project as listed in the table in **Appendix A**. One or more completed versions of these forms, as necessary, will be maintained in the project files. The types of documents and activities for which QC will be conducted and documented may include raw data, data from other sources such as data bases or literature, data entry into the TGIT tool, calculations necessary to transform raw data into forms required for TGIT entry, and comparisons of primary estimates with QC estimates.

Technical reviews will be used along with other technical assessments (i.e., QC checks) and QA audits to corroborate the scientific defensibility of any data analyses. A technical review (i.e., internal senior review) is a documented critical review of a specific technical work product. It is conducted by subject matter experts who are collectively equivalent (or senior) in technical expertise to those who performed the work. Given the nature of the deliverables under this project, a technical review is an in-depth assessment of the assumptions, calculations, extrapolations, alternative interpretations, and conclusions in technical work products. Technical review of proposed methods and associated data will be documented in the *QC Documentation Form* shown in **Appendix B**. The form will include the reviewer's charge, comments, and corrective actions taken.

Additionally, HPUL has developed and instituted document control mechanisms for the review, revision, and distribution of QAPPs. Each QAPP has a signed approval form, title page, table of contents, and an EPA-approved document control format (see header at top of the page). The distribution list for this QAPP was presented in **Table 1.1**. During the course of the project, any revision to the QAPP will be circulated to everyone on the distribution list, as well as to any additional staff supporting this project. Any revision to the QAPP will be documented in a QAPP addendum, approved by the same signatories to this QAPP, and circulated to everyone on the distribution list by the HPUL PM.

At this time, HPUL does not know if the project will collect or handle personally identifiable information (PII) subject to the Privacy Act of 1974. However, if during the course of this project technical staff determine that PII is required to support project objectives, HPUL will meet all requirements of the Privacy Act of 1974. **Appendix C** indicates the status of the tribe's determination regarding applicability of the Privacy Act of 1974 under this project.

# 2. Existing Data Acquisition and Management Protocols (Group B)

## 2.1. Sampling Process Design

### 2.1.1. Need and Intended Use of Data Used

As indicated in **Tables 2.1–2.4**, a wide range of data for a diverse set of GHG-emitting activity is necessary to prepare a tribal inventory. Existing data resource may include source-specific or facility-specific GHG emissions estimates, emissions factors, or activity data for use with emissions factors. The experimental design for this inventory project relies on the EPA's TGIT tool together with independent estimates prepared by HPUL assigned QC staff. Existing data resources (including but not limited to data from previously completed inventories) will be utilized to develop the primary GHG emissions estimates using the EPA's TGIT tool.

Subsequently, QC staff will complete an independent assessment of proper use of the original data source and will validate that the original data was properly transformed for the primary entries into the TGIT tool. As directed by the PM or QA Manager for a portion of each primary analysis, the assigned QC staff will populate a QC version of the TGIT tool with the validated data and compare the estimates in the primary versions of the TGIT worksheets with the estimates in the QC version of the TGIT worksheets. Any discrepancies between the primary and QC estimates will be reviewed by the PM or QAM and documented including the steps taken to reconcile any significant differences.

### 2.1.2. Identification of Data Sources and Acquisition

The following data sources will be evaluated for use under each task to develop primary estimates for the major-emitting sectors in HPUL or for use in validation of the primary estimates:

- Task 1:
    - Vehicle registration data from the California Department of Motor Vehicles.
    - State or federal averages for vehicle miles traveled and miles per gallon from the U.S. Department of Transportation.
    - National Emissions Inventory (NEI) county-level estimates for mobile sources.

- Task 2:
    - Electricity consumption by customer class obtained directly from Pacific Gas and Electric.
    - U.S. Department of Energy's (DOE's) EIA Form 861, which reports sub-county-level usage in MWh and customer counts as reported by the different distribution utilities operating within each county.
    - U.S. Department of Energy's (DOE's) SLOPE Platform which reports county-level electricity usage in million British thermal units.
- Task 3:
    - Area calculations from web-based map applications.
    - Tree cover estimates from tribal surveys or forestry databases.

- Task 4:
    - Data published by EPA under the Greenhouse Gas Reporting Program for fossil fuel consumption by customer class from Pacific Gas and Electric.
    - Wastewater management data from Lake County Sanitation District

## 2.2. Quality Control

All data operations conducted for this project will involve existing, non-direct measurement data. All data received will be reviewed by a senior technical staff member to assess data quality and completeness before their use. In addition to reviewing and assessing the data collected, all data entered into spreadsheets and all calculations completed for analyses will be reviewed by a senior technical QC reviewer. The QC reviewer will evaluate the approach to ensure the methods are appropriate and have been applied correctly to the analysis. The QC reviewer will also confirm all data were entered correctly and that calculations are complete and accurate. Calculations will be checked by repeating each calculation, independently, and comparing the results of the two calculations. Any data entry and calculation errors will be identified and corrected. Data tables prepared for the draft and final reports will be checked against the spreadsheets used to store the data and complete the analysis.

Where calculations are required to assess the data/datasets, QC calculations will be performed using computer spreadsheets and calculators to reduce typographical or translation errors–mathematical/ statistical calculations are performed using spreadsheets or software programs with predefined formulas and functions. HPUL will ensure that any manipulations performed on the data/dataset were done correctly. Such calculations could involve statistical checks to look for data outliers. One approach, for example, that may be used to identify outliers or unusual data points is sorting a datasheet for one or more data variables. This approach is a simple but effective way to highlight unusually high or low values. Graphing data using boxplots, histograms, and scatterplots is another method that may be used to identify gaps in the data (missing data), outliers, or unusual data points. Another approach that may be used is the use of Z-scores, which can quantify the unusualness of an observation when data follow a normal distribution. A Z-score for a particular value indicates the number of standard deviations above and below the mean that the value falls. For example, a Z-score of 2 indicates that an observation is two standard deviations above the average while a Z-score of -2 indicates the value is two standard deviations below the mean. A Z-score of zero represents a value that equals the mean. As appropriate, we will also use hypothesis tests to find outliers, or an interquartile range (IQR) to calculate boundaries for what constitutes minor and major outliers. The methods used will be driven by the scale and type of data. HPUL will determine outlier detection methods to be used based on the initial review of the data. Identified outliers will be highlighted to the PM, TL, QAM, or delegate with options for treatment.

## 2.3. Non-direct Measurements

All data operations conducted on this project will involve existing, non-direct measurement data. All existing data received will be reviewed by a senior technical staff member to assess data quality and completeness before their use.

Consistent with the EPA's QA requirements, this QAPP describes the procedures that will be used to ensure the selection of appropriate data and information to support the goals and objectives of this project. Specific elements addressed by this QAPP include:

- Identifying the sources of existing data,
- Presenting the hierarchy for data selection,
- Describing the review process and data quality criteria,
- Discussing quality checks and procedures should errors be identified, and
- Explaining how data will be managed, analyzed, and interpreted.

Data presented in the GHG inventory will be traced to its source (e.g., database input and output). Key resources include data collected by the EPA (e.g., GHGRP data), and data from EPA-approved data sources (e.g., EIA Form 861 data). These sources may include primary literature (i.e., peer-reviewed journal articles and reports) or databases. We may also use approved existing sources (e.g., handbooks, databases). Original sources for all information and data contained in the document will be included in a list of references with appropriate citations. When peer-reviewed literature or EPA-approved data sources cannot be used, we will document any significant limitations to the data sources used.

We will document information regarding each dataset and our rationale/selection criteria for selecting the data sources used in the inventory. The TL will be responsible for overseeing and confirming the selection of the data for the project tasks.

**Table 3.1** provides a hierarchy for data quality when identifying and reviewing available sources of data and information. When evaluating data resources, efforts will be made to identify and select data sources that most closely conform to the highest ranked criteria. Data quality metrics and documentation may not be provided by each source, and as necessary, we may consult with subject matter experts from permitted facilities or trade associations operating in HPUL to qualify data for use to meet project objectives.

Any available data quality information will be reviewed by HPUL and project advisors to ensure that the data represent full-scale designs and commercial processes, and that they are applicable to economic and regulatory conditions in the United States. HPUL will document data sources used and any significant limitations of utilized data or information to ensure that the data are appropriate for their intended use. An internal technical reviewer will review the approach for selecting and compiling data; the review will include examination of the data sources and the intended use of the data. The specific QC techniques used will depend on the technical activity or analysis to which they are applied. The HPUL TL is responsible for verifying the usability of data and related information.

**Table 3.1** Existing Data Quality Ranking Hierarchy

| **Quality Rank** | **Source Type** |
|---|---|
| Highest | Federal, state, and local government agencies |
| Second | Consultant reports for state and local government agencies |
| Third | NGO studies; peer-reviewed journal articles; trade journal articles; conference proceedings |
| Fourth | Conference proceedings and other trade literature: non-peer-reviewed |
| Fifth | Individual estimates (e.g., via personal communication with vendors) |

HPUL will work with EPA to ensure that all data used for the project are appropriate for their intended use. The main criteria that will be used in the selection of the data are the vintage and quality of the data (based on peer review). The quality of the data will consider the credibility of the source, and the QA documentation provided by the data source. Senior technical staff will also evaluate the availability of alternative datasets, suitability of the selected data for the intended purpose, and agreement with TGIT estimates.

HPUL will use the Secondary Data Quality Ranking Hierarchy when identifying and reviewing available sources of data and information. The source types in **Table 3.1** appear in the order in which they are likely to meet the data quality criteria. For example, federal government data are more likely to be from a credible source, thoroughly reviewed, suitable, available, and representative, and any exceptions to these data criteria are likely to be noted in the government data, providing transparency. Data from individuals are expected to be less reliable, not peer reviewed, and may not be suitable or representative of tribal activities.

If it is determined that data meeting the fourth (i.e., conference proceedings and other trade literature: non peer-reviewed) or fifth (i.e., individual estimates such as personal communications with vendors) level compose the best or only available data source, the TL will include in the inventory a description of these data with associated limitations for review and approval by the PM and QAM.

These measures of data quality will be used to judge whether the data are acceptable for their intended use. In cases where available data do not or may not meet data quality acceptance criteria, the TL will include in the inventory a discussion for review and approval by the PM and QAM explaining how emissions estimates that relied on such data compare to TGIT estimates.

We will also consider, for example, the age (i.e., date of the source dataset) and the representativeness of the data and will include in the inventory report for review and approval by the PM and QAM any quality concerns or uncertainties introduced with use of these data, such as data gaps or inconsistencies with other sources. Any data source utilized that is older than 10 years will specifically be flagged in the inventory report.

Representativeness will be evaluated by determining that the emissions or activity data are descriptive of conditions in the United States, that the data are current, and that the data are descriptive of similar processes within HPUL. Any incomplete datasets will be identified, and deficiencies will be evaluated to determine whether data are missing or confusing and if they meet secondary-use quality objectives.

Key screening criteria will be used to screen the sources identified. The HPUL TL will provide oversight to the screening process to ensure sources collected are the most relevant and meet quality requirements. Available data and information from the selected sources will be compiled and relevant summary information will be extracted out of the information sources to develop the required output for each of the project tasks.

### 2.3.1. Criteria for Accepting Existing Data for Intended Use

The criteria for determining whether the data are acceptable for use in developing the tribal inventory will be based on a comparison of the primary emissions estimates to independent emissions estimate produced using the EPA's TGIT or other reliable sources of activity data. While some differences between the tribe's primary calculations and independent calculations are expected, differences of more than 20 percent must be accompanied by an explanation subject to approval by the PM and QAM prior to using the estimate in the tribe's inventory.

### 2.3.2. Criteria for Options Identification

The criteria for reviewing all activities under each task and identifying the best options for future emissions reductions projects will be based on the following criteria:

1. Quantity of reductions in emissions of climate pollution under the option.
2. Number of jobs likely to be created by the option.
3. Environmental justice benefits of the project including the number of people living in overburdened neighborhoods that will benefit from the option.
4. Quantity of reductions in criteria and toxic air pollutants that can be achieved by option.
5. Number of people living, working, recreating, and going to school in the area(s) benefiting from the option.

## 2.4. Data Management

Data management procedures include file storage and file transfer. All project and data files will be stored on HPUL project servers. Files will be organized and maintained by the TL in folders by project, task, and function, including a system of file labeling to ensure version control. Any files containing confidential business information will be stored on secure computers. The TL will make sure that staff are trained and adhere to the project file organization and version control labeling to ensure that files are placed in consistent locations. All files will be backed up each night to avoid loss of data. Data are stored in various formats that correspond to the software being used. As necessary, data will be transferred using various techniques, including email, File Transfer Protocol, or shared drives. Typically, records will be archived once the project is completed. Record retention times will be based on contractual and statutory requirements or will follow HPUL practices for storing materials of up to 10 years after the end of the period of performance (POP). Multiple project staff are granted access rights to the archived file system for each project. Records may be retrieved from archived file system by the TL, PM, or other project staff with access during the records retention period. As soon as allowed by applicable regulations or the grant agreement, records will be destroyed according to HPUL policies and procedures. For any sensitive information that is gathered under the project, HPUL's policy is consistent with EPA–recommended methods of destruction, which include degaussing, reformatting, or secure deletion of electronic records; physical destruction of electronic media; recycling; shredding; incineration; and pulping. Should the grant specify some other manner of disposition (e.g., transfer to the client), HPUL will comply with that directive. As noted above, HPUL has developed a file naming convention/ nomenclature for electronic file tracking and record keeping. Foremost, all files must be given a short but descriptive name. For those records and files gathered or provided to HPUL, the filename may include the identification of "original" in its filename.

Similarly, files that have undergone a review by an independent, qualified person will include, at the end of the filename, the initials of the reviewer or the suffix "rev" (in lieu of initials) if more than one reviewer reviewed the file, along with the date reviewed and version number, as a way to track which staff person(s) reviewed the file and when. Filenames of draft versions will follow an incremental, decimal numbering system. More specifically, each successive draft of a document is numbered sequentially from version 0.1, 0.2, 0.3… until a final version is complete. Final versions will be indicated by whole numbers (e.g., version 1.0). Final versions of documents that undergo revisions will be labeled version X.1 for the first set of revisions. While the document is under review, subsequent draft versions will increase incrementally (e.g., 1.2, 1.3, 1.4) until a revised final version is complete (e.g., version 2.0).

In the event data retrieval is requested and to prevent loss of data, all draft and final file versions will be retained electronically—that is, superseded versions will not be deleted.

Note that changes made to deliverables will be documented using the software's *track changes* feature, which allows a user to track and view all changes that are made to the document version. All deliverable reviews will be documented in a QC Documentation Form (see **Appendix B**) for the project. This form will be maintained in the project files.

For this project, it is not anticipated that any special hardware or software will be used. General software available through the Microsoft Suite including Excel, PowerPoint, Access, and Word will be sufficient to perform the work (described in **Tables 2.1–2.4)** for this project.

## 3. Assessment and Oversight (Group C)

HPUL is committed to preparing a comprehensive and reliable inventory of GHG emissions for HPUL. Under this project our senior management team has dedicated the necessary resources to ensure we deliver an inventory that can be relied upon for future policy decisions. Accordingly, under this project, we will concurrently implement existing quality management systems that HPUL has previously utilized for submissions to the EPA under Title I of the Act where task-level deliverables will be subjected to required, regular reviews (e.g., quarterly) to ensure that technical, financial, and schedule requirements of this project are consistent with the EPA PO's and QAM's expectations for handling and producing deliverables that reflect high-quality environment data. This section discusses Elements C1 (assessments and response actions) and C2 (reporting) applicable to this project.

### 3.1. Assessments and Response Actions

The QA program includes periodic review of data files and draft deliverables. The essential steps in the QA program are as follows:

1. Identify and define the problem
2. Assign responsibility for investigating the problem
3. Investigate and determine the cause of the problem
4. Assign and accept responsibility for implementing appropriate corrective actions
5. Establish the effectiveness of and implement the corrective action
6. Verify that the corrective action has eliminated the problem.

The TL will provide day-to-day oversight of the quality system. Periodic project file reviews will be carried out by the QA Manager, at least once per year to verify that required records, documentation, and technical review information are maintained in the files. The QAM will ensure that problems found during the review are brought to the attention of the TL and are corrected immediately. All nonconforming data will be noted, and corrective measures to bring nonconforming data into conformance will be recorded.

The TLs and QA Manager are responsible for determining whether the quality system established for the project is appropriate and functioning in a manner that ensures the integrity of all work products. All technical staff have roles and will participate in the corrective action process. Corrective actions for errors found during QC checks will be determined by the TL and, if necessary, with direction from the QA Manager or PM, as appropriate. The originator of the work will make the corrections and will note on the QC form that the errors were corrected. A reviewer or TL, not involved in the creation of the work, will review the corrections to ensure the errors were corrected. Any problems noted during audits will be reviewed and corrected by the QA Manager and discussed with the TL as needed. Depending on the severity of the deficiency, the TL may consult the QA Manager and stop work until the cited deficiency is resolved. Deficiencies identified and their resolution will be documented in monthly project reports, as applicable. The QA Manager and TL will comply and respond to all internal and EPA audits on the project, as needed. The QA Manager will produce a report outlining any corrective actions taken.

### 3.2. Reports to Management

The periodic progress reports (to the EPA PO) required in the grant agreement will be reviewed by the PM (Rodney Williams), the Technical Project Coordinator (John Murphy), and the HPUL Approver (Sherry Treppa) to ensure the project is meeting milestones and that the resources committed to the project are sufficient to meet project objectives. These periodic progress reports will describe the status of the project, accomplishments during the reporting period, activities planned for the next period, and any special problems or events including any QA/QC issues. Reports to the EPA will be drafted by the TL or other project staff familiar with project activities during the reporting period.

Any QC issues impacting the quality of a deliverable, the project budget, or schedule will be identified and promptly discussed with the assigned TL and the PM or QAM as appropriate. All significant findings will be included in monthly reports with the methods used to resolve the specific QC issue or the recommendations for resolution for consideration by the EPA's PO or designee.

Based on the technical work completed during the reporting period, progress reports will be reviewed internally by an independent, qualified technical person (equivalent or senior to the TL), prior to submitting to the PM. The PM will conduct a final review of the report before transmitting the progress report to the EPA PO, and the PM's manager will be cc'd on all progress reports.

# 4. Data Validation and Usability (Group D)

## 4.1. Data Review, Verification, Validation

All work conducted under this project will be subject to technical and editorial review. When existing data for the same GHG-emitting activity are available from multiple sources, the background information documents will be reviewed for all sources to determine the dataset that is the most representative of tribal operations. Additionally, the inventory report will include the vintage of the existing data resource and preference will be given to the most recent dataset that is representative of similar GHG-emitting tribal activities. Reviews will be conducted by an independent, qualified person—or a person not directly involved in the production of the deliverable. The term "validation" refers to whether the data meet the QAPP-defined user requirements while the term "verification" refers to whether conclusions can be correctly drawn from the data. The quality of data used and generated for the project will be reviewed and verified at multiple levels by the project team. This review will be conducted by the HPUL TL or a senior technical reviewer with specific, applicable expertise. All original and modified data files will be reviewed for input, handling, and calculation errors. Additionally, all units of measure will be checked for consistency. Any potential issues identified through this review process will be evaluated and, if necessary, data will be corrected, and analysis will be revised as necessary, using corrected data. These corrections will be documented in project records. These measures of data quality will be used to judge whether the data are acceptable for their intended use. In cases where available data do not or may not meet data quality acceptance criteria, the TL will document these findings in the inventory along with corrective actions or use of alternative data sources.

## 4.2. Verification and Validation Methods

As a standard operating procedure, all data (retrieved and generated) will be verified and validated through a review of data files by an independent, qualified technical staff member (i.e., someone other than the document originator), and ultimately, the HPUL TL. A checklist of QC activities for deliverables under this project is provided as **Appendix A**. Forms for documenting QC activities and review of deliverables are included in **Appendix B**. Documentation of calculations will be included in spreadsheet work products and in supporting memoranda, as appropriate.

The TL is responsible for day-to-day technical activities of tasks, including planning, data gathering, documentation, reporting, and controlling technical and financial resources. The TL is the primary person responsible for quality of work on tasks under this project and will approve all-related plans and reports. These reports will be transmitted by the TL to the QAM for final review and approval.

Source data will be verified and validated through a review of data files by the technical staff, and ultimately the TL. Reviews of analyses will include a thorough evaluation of content and calculated values. All original and modified data files will be reviewed for input, handling, and calculation errors. Additionally, all measurement units will be checked for consistency. Any potential issues identified through this review process will be evaluated, errors corrected, and analysis repeated using the corrected data. All corrections will be documented in project records.

Source data will be verified and validated through a review of data files by the technical staff, and ultimately the TL. Typical data verification reviews can include checks of the following:

- Data sources are clearly documented,
- Calculations are appropriately documented,
- All relevant assumptions are clearly documented,
- Conclusions are relevant and supported by results, and
- Text is well-written and easy to understand.

The documented review process will be stored with deliverables for the project. For the narrative describing the methodologies used for the inventory, all comments on drafts will be clearly and concisely summarized including a description of how substantive issues raised by commenters were resolved.

As discussed in Section 1.7, QC objectives include verification that data in database tables are stored and transferred correctly, algorithms call data correctly, units are internally consistent, and reports pull the required data. These data management issues will be addressed as part of the QC checks of data acquisition and document preparation.

For this project, it is not anticipated that any special data validation software will be required. However, where calculations are required to assess the data/datasets, calculations will be performed using computer spreadsheets (like Excel spreadsheets with predefined functions, or formulas) and calculators to reduce typographical or translation errors. General software available through the Microsoft Suite including Excel, PowerPoint, Access, and Word will be sufficient to perform the work as described in Section 1.6 for this project.

### 4.3. Reconciliation with User Requirements

All data (retrieved and generated) and deliverables in this project will be analyzed and reconciled with project data quality requirements. To ensure deliverables meet user requirements, the TL or senior technical lead will review all data and deliverables throughout the project to ensure that the data, methodologies, and tools used meet data quality objectives, are clearly conveyed, and represent sound and established science.

HPUL will review each project with the EPA at the planning stage to ensure the approach is fundamentally sound and will meet the project objectives. The TL or senior technical lead will evaluate data continuously during the life term of the project to ensure they are of sufficient quality and quantity to meet the project goals. Prior to submission of draft and final products, the TL or senior technical lead will make a final assessment to determine whether the objectives have been fulfilled in a technically sound manner. Assumptions made in preparing project analyses will be clearly specified in the inventory.

As discussed in Section 1.7.1, uncertainty can be evaluated using a few different approaches. The most useful uncertainty analysis is quantitative and is based on statistical characteristics of the data such as the variance and bias of estimates. In a sensitivity analysis, the effect of a single variable on the resulting emissions estimate generated by a model (or calculation) is evaluated by varying its value while holding all other variables constant. Sensitivity analyses will help focus on the data that have the greatest impact on the output data. Additional statistical tests may be utilized depending on the need for more or less rigorous tools and on the specific inventory activity being evaluated.

## 5. References

EPA, *Chief Information Officer's Policy Directive on Environmental Information Quality Policy* available at EPA IT/IM Directive: Environmental Information Quality Policy, Directive # CIO 2105.3. Accessed on 7/26/2023.

EPA, Chief Information Officer's Policy Directive on Information Technology / Information Management: Quality Assurance Project Plan (QAPP) Standard, Directive # CIO 2105-S-02.0. Available at https://www.epa.gov/irmpoli8/quality-assurance-project-plan-qapp-standard. Accessed on 7/24/2023.

EPA, EPA-454/B-17-001, *Quality Assurance Handbook for Air Pollution Measurement Systems, Ambient Air Quality Monitoring Program, Volume II*. Available at https://www3.epa.gov/ttnamti1/files/ambient/pm25/qa/Final%20Handbook%20Document%201_17.pdf. Accessed on 6/23/2023.

EPA, Fact Sheet: Areas where differences between state GHG inventories and the EPA's Inventory of U.S. GHG Emissions and Sinks by State: 1990-2020 estimates may occur. Available at https://www.epa.gov/system/files/documents/2022-03/fact-sheet-differences-epa-and-offical-state-ghgi.pdf. Accessed on 7/31/2023.

EPA, Greenhouse Gas Reporting Program (GHGRP) at https://www.epa.gov/ghgreporting/data-sets. Accessed on 7/26/2023.

EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021* at https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2021. Accessed on 7/26/2023.

EPA, *State and Tribal Greenhouse Gas Data and Resources* at https://www.epa.gov/ghgemissions/state-and-tribal-greenhouse-gas-data-and-resources. Accessed on 7/26/2023.

EPA, Fuel heating values and CO2 emission factors at eCFR :: 40 CFR Part 98 -- Mandatory Greenhouse Gas Reporting. Accessed on 7/26/2023.

EPA, Global warming potentials at https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-98/subpart-A?toc=1. Accessed on 7/26/2023.

USDA Forest Service, *Greenhouse gas emissions and removals from forest land, woodlands, and urban trees in the United States, 1990-2019* at https://www.fs.usda.gov/research/treesearch/62418. Accessed on 7/26/2023.

US DOT, *Highway Statistics Series* at https://www.fhwa.dot.gov/policyinformation/statistics/2021/vm1.cfm. Accessed on 7/26/2023.

## Appendix A: Check Lists of Quality Control Activities for Deliverables

| Tasks/Deliverables | Quality Control Procedures |
|---|---|
| **Task 1. Mobile Combustion (Transportation)** | |
| Tribal inventory of GHG emissions from mobile sources with documentation of the following QC activities:<br><br>(1) narrative report describing data sources and QC measures for data acquisition steps,<br><br>(2) description of methodology and QC measures for validated proper implementation of methodology, and<br><br>(3) documentation of QAPP implementation. | 1. Comparison of tribal estimate of average miles traveled per year and average miles per gallon (by vehicle type) versus state and national averages. |

| Vehicle Type | Tribal Avg Miles/yr | State Avg[18] Miles/yr | MPY Statistics* | Tribal Avg Miles/gal | National Avg Miles/gal[19] | MPG Statistics |
|---|---|---|---|---|---|---|
| Passenger Car (Gasoline) | | | Signed Bias ±TBD%<br><br>Variance TBD% | | 24.1 | Signed Bias ±TBD%<br><br>Variance TBD% |
| Passenger Truck (Gasoline) | | | | | 18.5 | |
| Heavy-duty (Gasoline) | | | | | 10.1 | |
| Motorcycle (Gasoline) | | | | | 50 | |
| Passenger Car (Diesel) | | | | | 32.4 | |
| Passenger Truck (Diesel) | | | | | 22.1 | |
| Heavy-duty (Diesel) | | | | | 13.0 | |

* Precision and bias calculations will be in accordance with the EPA's Data Assessment Statistical Calculator (DASC) Tool available at https://www.epa.gov/sites/default/files/2020-10/dasc_11_3_17.xls with the tribe's estimate taken as the measured value and the TGIT value taken as the audit value. . Note that the formulas in the DASC Tool will be used to calculate signed bias and variance.

2. For any values used in tribal inventory that differ from the state average MPY or the national average MPG by more than 10 %, the tribe will provide an explanation of why tribal factors may differ from state or national averages.

3. Review by TL or senior technical reviewer—analytical methods / results are explained clearly, technical terms are defined, conclusions are reasonable based on information presented, and level of technical detail is appropriate.

4. Editor review—verify or remediate draft deliverables to ensure clear, error-free writing.

[18] U.S. Department of Transportation, Federal Highway Administration. Highway Statistics 2020. Available at https://www.fhwa.dot.gov/policyinformation/statistics/2020/ . Accessed on June 30, 2023.

[19] National average miles per gallon from [tribal_community_ghg_inventorytool.xlsm] workbook and the [Mobile-Entry] worksheet.

| Tasks/Deliverables | Quality Control Procedures |
|---|---|

**Task 2. Electric Power Consumption**

Tribal inventory of GHG emissions from electric power consumption with documentation of the following QC activities:

(1) narrative report describing data sources and QC measures for data acquisition steps,

(2) description of methodology and QC measures for validated proper implementation of methodology, and

(3) documentation of QAPP implementation.

1. Compare (a) the primary tribal estimate with the TGIT *versus* (b) the tribal QC estimate developed for the subset of power consuming sectors specified by the PM or QAM. Use a table similar to the table below to assess precision and bias of the primary estimates versus the QC estimates.

| Power Consuming Sector | Primary Tribal TGIT Estimate (Metric Tons $CO_2e$) | QC TGIT Estimate (Metric Tons $CO_2e$) | Statistics* |
|---|---|---|---|
| Residential | | | Signed Bias ±TBD%<br><br>Variance TBD% |
| Commercial | | | |
| Industrial | | | |
| Transportation | | | |
| Other | | | |

* Precision and bias calculations will be in accordance with the EPA's Data Assessment Statistical Calculator (DASC) Tool available at https://www.epa.gov/sites/default/files/2020-10/dasc_11_3_17.xls with the tribe's estimate taken as the measured value and the SIT value taken as the audit value. Note that the formulas in the DASC Tool will be used to calculate signed bias and variance.

Ensure the GWPs used for the primary TGIT estimate and the QC estimate are on the same basis. The TGIT tool uses AR5 GWP (e.g., $CH_4$ GWP = 28).

2. Technical review of methods, calculations, and underlying datasets—data are appropriate for intended use, data are complete and representative and current, data sources documented, analytical methods are appropriate, and calculations are accurate.

3. Review by TL or senior technical reviewer—analytical methods and results are explained clearly, technical terms are defined, conclusions are reasonable based on information presented, and level of technical detail is appropriate)

4. Editor review—writing is clear, free of grammatical and typographical errors.

| Tasks and Deliverables | Quality Control Procedures |
|---|---|
| **Task 3. Urban Forestry (Natural Working Lands and Forestry)** | |
| Tribal inventory of GHG emissions and sinks from natural and working lands and forestry with documentation of the following QC activities:<br><br>(1) narrative report describing data sources and QC measures for data acquisition steps,<br><br>(2) description of methodology and QC measures for validated proper implementation of methodology, and<br><br>(3) documentation of QAPP implementation. | 1. Compare (a) the tribal estimate for sector(s) with largest area of tree cover developed by assigned technical staff member under Task 3 *versus* (b) independent estimate for same sector(s) by assigned QC staff that did not support initial estimates. Use a table similar to the table below to assess precision and bias of the primary estimates versus QC estimates: |

| Sector | Primary Tribal Estimate Area ($km^2$) | Estimate by QC Staff Area ($km^2$) | Statistics* for Area Comparisons | Primary Tribal Estimate Tree Cover (%) | Estimate by QC Staff Tree Cover (%) | Statistics* for Tree Cover Comparisons |
|---|---|---|---|---|---|---|
| Residential Area 1 | | | Signed Bias ±TBD%<br><br>Variance TBD% | | | Signed Bias ±TBD%<br><br>Variance TBD% |
| Residential Area 2 | | | | | | |
| Residential Area 3 | | | | | | |
| Residential Area … | | | | | | |
| Comm. / Institutional Area 1 | | | Signed Bias ±TBD%<br><br>Variance TBD% | | | Signed Bias ±TBD%<br><br>Variance TBD% |
| Comm. / Institutional Area 2 | | | | | | |
| Comm. / Institutional Area 3 | | | | | | |
| Comm. / Institutional Area … | | | | | | |

* Precision and bias calculations will be in accordance with the EPA's Data Assessment Statistical Calculator (DASC) Tool available at https://www.epa.gov/sites/default/files/2020-10/dasc_11_3_17.xls with the tribe's estimate taken as the measured value and the SIT value taken as the audit value. . Note that the formulas in the DASC Tool will be used to calculate signed bias and variance.

2. Technical review of methods, calculations, and underlying datasets—data are appropriate for intended use, data are complete and representative and current, data sources documented, analytical methods are appropriate, and calculations are accurate. Include any QC findings and reconciliation.
3. Review by TL or senior technical reviewer—analytical methods and results are explained clearly, technical terms are defined, conclusions are reasonable based on information presented, and level of technical detail is appropriate)
4. Editor review—writing is clear, free of grammatical and typing errors.

| Tasks and Deliverables | Quality Control Procedures |
|---|---|
| **Task 4. State Inventory of GHG Emissions for Other Sources** | |
| Tribal inventory of GHG emissions from the tribe's other sources with documentation of the following QC activities:<br><br>(1) narrative report describing data sources and QC measures for data acquisition steps,<br><br>(2) description of methodology and QC measures for validated proper implementation of methodology, and<br><br>(3) documentation of QAPP implementation. | 1. Comparison of (a) primary tribal emissions estimates *versus* (b) tribal QC estimates, with both estimates developed using the EPA's Tribal-GHG Inventory Tool (TGIT) for stationary combustion, solid waste, wastewater treatment, water, agriculture & land management, waste generation.<br>2. For any primary estimates that are inconsistent with QC estimates, the table below will be utilized to assess precision and bias of the primary estimates versus the QC estimates: |

| Other Sectors | Primary Estimate (Metric Tons CO2e) | QC Estimate (Metric Tons CO2e) | Statistics* |
|---|---|---|---|
| Stationary combustion | | | Signed Bias ±TBD%<br><br>Variance TBD% |
| Agriculture & land management | | | |
| Waste generation | | | |
| Solid waste | | | |
| Water | | | |
| Wastewater treatment | | | |
| Other | | | |

* Precision and bias calculations will be in accordance with the EPA's Data Assessment Statistical Calculator (DASC) Tool available at https://www.epa.gov/sites/default/files/2020-10/dasc_11_3_17.xls with the tribe's estimate taken as the measured value and the SIT value taken as the audit value. . Note that the formulas in the DASC Tool will be used to calculate signed bias and variance.

3. Technical review of methods, calculations, and underlying datasets—data are appropriate for intended use, data are complete and representative and current, data sources documented, analytical methods are appropriate, and calculations are accurate.
4. Review by TL or senior technical reviewer—analytical methods and results are explained clearly, technical terms are defined, conclusions are reasonable based on information presented, and level of detail appropriate.
5. Editor review: writing is clear, free of grammatical and typographical errors.

# Appendix B: Example QC Documentation Form

**Habematolel Pomo of Upper Lake**

**Documentation of QA Review and Approval of Electronic Deliverables**

*Approvals on this form verify that all technical and editorial reviews have been completed and the deliverable meets the criteria for scientific defensibility, technical, and editorial accuracy, and presentation clarity as outlined in the Quality Assurance (QA) Project Plan, QA Narrative, Quality Management Plan, and/or according to direction from the EPA PO.*

| | |
|---|---|
| **Client:** | US EPA |
| **Grant Number:** | 98T79501 |
| **EPA Project Officer: Project Number: Project Name:** | Kathryn Harper Reserved Climate Pollution Reduction Plan |
| **Grantee Org. Project Manager** | Rodney Williams |

**QA Form Details**

| Item Number | File Name (Copy the name of the File Reviewed) | Deliverable Description | Date Sent to Client | Deliverable (Draft) | Deliverable (Final) | Document Originator | QA Review Information (Review Type) | (Reviewer Name) | (Date Review was Performed) | (Brief Summary of Review Findings and Other Notes) | QA Review Information (Have all Findings Been | (Originator Signature) | (Reviewer Signature) | (File Location) *Copy Long Folder Path Name* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | | | | ☐ | ☐ | | *Technical* | | | | ☐ Yes | | | |
| | | | | | | | *Technical* | | | | ☐ Yes | | | |
| 02 | | | | ☐ | ☐ | | *Technical* | | | | ☐ Yes | | | |
| | | | | | | | *Technical* | | | | ☐ Yes | | | |
| 03 | | | | ☐ | ☐ | | *Technical* | | | | ☐ Yes | | | |
| | | | | | | | *Technical* | | | | ☐ Yes | | | |
| 04 | | | | ☐ | ☐ | | *Technical* | | | | ☐ Yes | | | |
| | | | | | | | *Technical* | | | | ☐ Yes | | | |

## Appendix C: Compliance with Requirements Under the Privacy Act of 1974

**Important Note about Personally Identifiable Information (PII)**

The Privacy Act of 1974 (5 U.S.C. § 552a) mandates how federal agencies maintain records about individuals. Per OMB Circular A-130, Personally Identifiable Information (PII) is "information that can be used to distinguish or trace an individual's identity, either alone or when combined with other information that is linked or linkable to a specific individual."

EPA systems/applications that collect PII must comply with EPA's Privacy Policy and procedures to guard against unauthorized disclosure or misuse of PII in all forms. For more information click here. If PII are collected, then the QAPP will describe how the PII are managed and controlled.

**Personally identifiable information (PII):**

***Please verify one of the following two options by checking the corresponding box:***

1. This project **will not** collect Personally Identifiable Information (PII): X
2. This project **will** collect Personally Identifiable Information (PII): ☐

This QAPP will comply with 5 U.S.C. § 552a and EPA's Privacy Policy.

## Attachment 1: Example Tribal Electric Power Consumption Data Available from DOE / EIA Form 861

HPUL has requested power consumption data from Pacific Gas and Electric and will evaluate the availability and applicability of:

U.S. Department of Energy's (DOE's) EIA Form 861, which reports sub-county-level usage in MWh and customer counts as reported by the different distribution utilities operating within each county.

U.S. Department of Energy's (DOE's) SLOPE Platform which reports county-level electricity usage in million British thermal units.

**Attachment 2: Example Table of Tribal GHG Emitting Activities**

HPUL is not currently subject to EPA's Greenhouse Gas Reporting Program

# Appendix C

GHGenius Modeling Report

# ANALYSIS OF GHG EMISSIONS OF ENSYN CORPORATION'S BIO-OIL FROM RAPID THERMAL PROCESS (RTP)™ WOOD FEEDSTOCK

Prepared For:

**ENSYN CORPORATION**
**2 Gurdwara Road**
**Suite 210**
**Ottawa, Ontario**
**K2E 1A2**

Prepared By

**(S&T)$^2$ Consultants Inc.**
11657 Summit Crescent
Delta, BC
Canada, V4E 2Z2

Date: March 22, 2009

# EXECUTIVE SUMMARY

As environmental awareness increases, governments, industries and businesses have started to assess how their activities affect the environment. Society has become concerned about the issues of natural resource depletion and environmental degradation. The environmental performance of products and processes has become a key operational issue, which is why many organizations are investigating ways to minimize their effects on the environment. Many have found it advantageous to explore ways to improve their environmental performance, while improving their efficiency, reducing costs and developing a "green marketing" advantage. One such tool is called life cycle assessment (LCA). This concept considers the entire life cycle of a product.

Life cycle assessment is a "cradle-to-grave" (or "well to wheels") approach for assessing industrial systems. "Cradle-to-grave" begins with the gathering of raw materials from the earth to create the product and ends at the point when all materials are returned to the earth. An LCA evaluates all stages of a product's life from the perspective that they are interdependent, meaning that one operation leads to the next. LCA enables the estimation of the cumulative environmental impacts resulting from all stages in the product life cycle, often including impacts not considered in more traditional analyses (e.g., raw material extraction, material transportation, ultimate product disposal, etc.). By including the impacts throughout the product life cycle, LCA provides a comprehensive view of the environmental aspects of the product or process and a more accurate picture of the true environmental trade-offs in product selection.

LCA work involves the collection and utilization of large amounts of data and thus is ideally suited to the use of computer models to assist with the inventorying and analysis of the data. In North America, two models are widely used for the analysis of transportation fuels:

- GREET. A model developed by Argonne National Laboratory in the United States, and
- GHGenius. A model developed by Natural Resources Canada, which has data for both Canada and the United States. This model also has much greater flexibility for modelling different types of crude oil production and many more types of alternative fuels.

The GHGenius model has been developed for Natural Resources Canada over the past eight years by S&T Squared Consultants Inc. It is based on the 1998 version of Dr. Mark Delucchi's Life Cycle Emissions Model (LEM). GHGenius is capable of analyzing the emissions of many contaminants associated with the production and use of traditional and alternative transportation fuels.

GHGenius is capable of estimating life cycle emissions of the primary greenhouse gases and the criteria pollutants from combustion sources. The specific gases that are included in the model include:

- Carbon dioxide ($CO_2$),
- Methane ($CH_4$),
- Nitrous oxide ($N_2O$),
- Chlorofluorocarbons (CFC-12),
- Hydro fluorocarbons (HFC-134a),
- The $CO_2$-equivalent of all of the contaminants above.

- Carbon monoxide (CO),
- Nitrogen oxides (NOx),
- Non-methane organic compounds (NMOCs), weighted by their ozone forming potential,
- Sulphur dioxide ($SO_2$),
- Total particulate matter.

The scope of the work undertaken includes the use of two feedstocks, wood, and flax straw, to be pyrolysed in the Ensyn RTP™ system to produce bio-oil that would be utilized in thermal applications or as a fuel for use in a turbine to produce electricity. The wood is further broken down into wood mill residues and short rotation forestry material.

The modelling output includes energy use per unit of energy produced, the GHG emissions (g $CO_{2eq}$/unit of fuel produced), and other air contaminants. We have compared the results to both diesel fuel and natural gas in thermal applications and where the bio-oil is used to make electricity the emissions have been compared to electricity produced from coal, fuel oil, and natural gas. The fuel dispensing and vehicle operation stages of the lifecycle have not been added for this work as the fuel is used for non-vehicle applications. Separate reports have been prepared for the two feedstocks and this report covers the wood systems.

The lifecycle GHG emissions for the two wood feedstocks compared to the production and use of heating oil or natural gas are shown in the following table. The bio-oil production and use reduces GHG emissions from 76 to 88% depending on the source of the feedstock.

**Table ES- 1 GHG Emissions – Wood Feedstock**

| Fuel | Heating oil | Natural Gas | Bio-oil | Bio-oil |
|---|---|---|---|---|
| Feedstock | Crude Oil | Natural Gas | Wood residues | Short Rotation Forestry |
| | g $CO_{2eq}$/GJ | | | |
| Fuel dispensing | 402 | 0 | 874 | 875 |
| Fuel distribution and storage | 698 | 2,063 | 361 | 362 |
| Fuel production | 8,412 | 1,376 | 9,555 | 9,570 |
| Feedstock transmission | 1,401 | 0 | 0 | 1,264 |
| Feedstock recovery | 8,081 | 1,708 | 0 | 3,889 |
| Land-use changes, cultivation | 25 | 0 | 0 | 3,189 |
| Fertilizer manufacture | 0 | 0 | 0 | 1,475 |
| Gas leaks and flares | 1,900 | 3,540 | 0 | 0 |
| $CO_2$, $H_2S$ removed from NG | 0 | 642 | 0 | 0 |
| Emissions displaced | -128 | 0 | 0 | 0 |
| **Sub-Total Fuel production** | 20,790 | 9,330 | 10,790 | 20,623 |
| Fuel Combustion | 68,718 | 50,432 | 301 | 301 |
| **Grand Total** | **89,508** | **60,762** | **11,091** | **20,924** |
| % Change compared to heating oil | | -32.1% | -87.6% | -76.6% |

# TABLE OF CONTENTS

## LIST OF TABLES



## LIST OF FIGURES

# 1. INTRODUCTION

As environmental awareness increases, governments, industries and businesses have started to assess how their activities affect the environment. Society has become concerned about the issues of natural resource depletion and environmental degradation. The environmental performance of products and processes has become a key operational issue, which is why many organizations are investigating ways to minimize their effects on the environment. Many have found it advantageous to explore ways to improve their environmental performance, while improving their efficiency, reducing costs and developing a “green marketing” advantage. One such tool is called life cycle assessment (LCA). This concept considers the entire life cycle of a product.

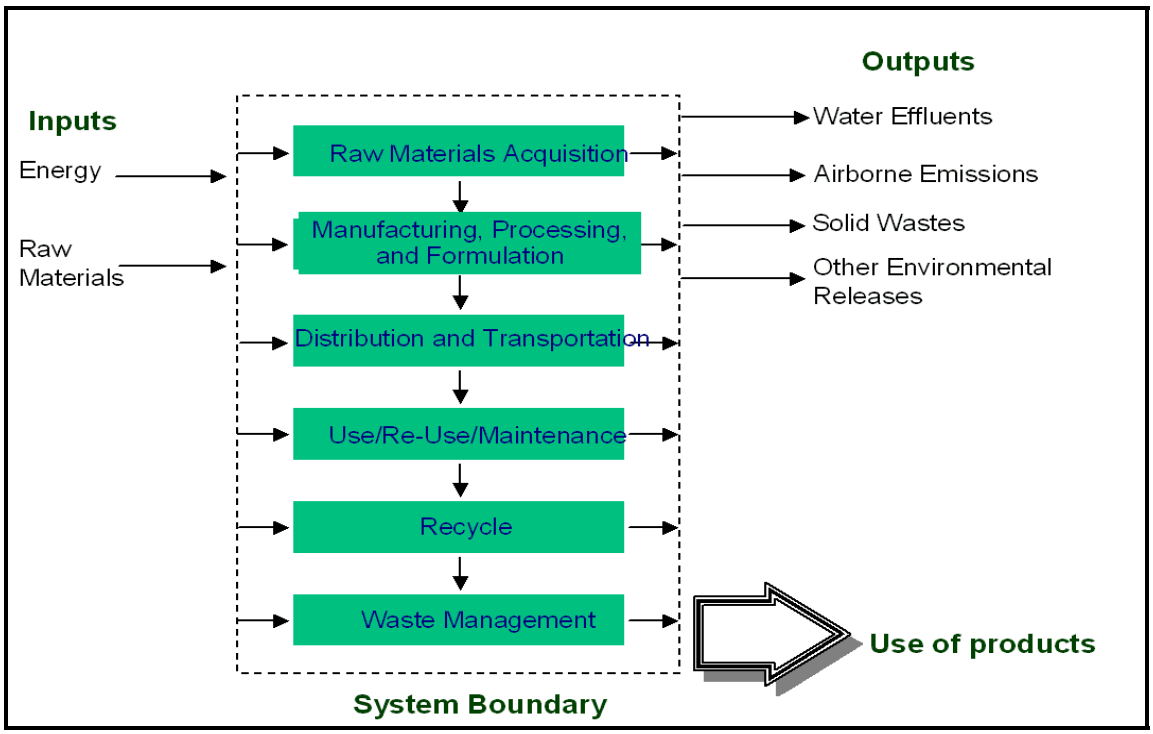
Life cycle assessment is a "cradle-to-grave" (or “well to wheels”) approach for assessing industrial systems. "Cradle-to-grave" begins with the gathering of raw materials from the earth to create the product and ends at the point when all materials are returned to the earth. An LCA evaluates all stages of a product's life from the perspective that they are interdependent, meaning that one operation leads to the next. LCA enables the estimation of the cumulative environmental impacts resulting from all stages in the product life cycle, often including impacts not considered in more traditional analyses (e.g., raw material extraction, material transportation, ultimate product disposal, etc.). By including the impacts throughout the product life cycle, LCA provides a comprehensive view of the environmental aspects of the product or process and a more accurate picture of the true environmental trade-offs in product selection.

Specifically, LCA is a technique to assess the environmental aspects and potential impacts associated with a product, process, or service, by:

- Compiling an inventory of relevant energy and material inputs and environmental releases;
- Evaluating the potential environmental impacts associated with identified inputs and releases;
- Interpreting the results to help make more informed decisions.

The term "life cycle" refers to the major activities in the course of the product's life span from its manufacture, use, maintenance, and final disposal; including the raw material acquisition required to manufacture the product. The following figure illustrates the typical life cycle stages that can be considered in an LCA and the quantified inputs and outputs.

**Figure 1-1 Life Cycle Stages**




The LCA process is a systematic, iterative, phased approach and consists of four components: goal definition and scoping, inventory analysis, impact assessment, and interpretation as illustrated in the following figure:

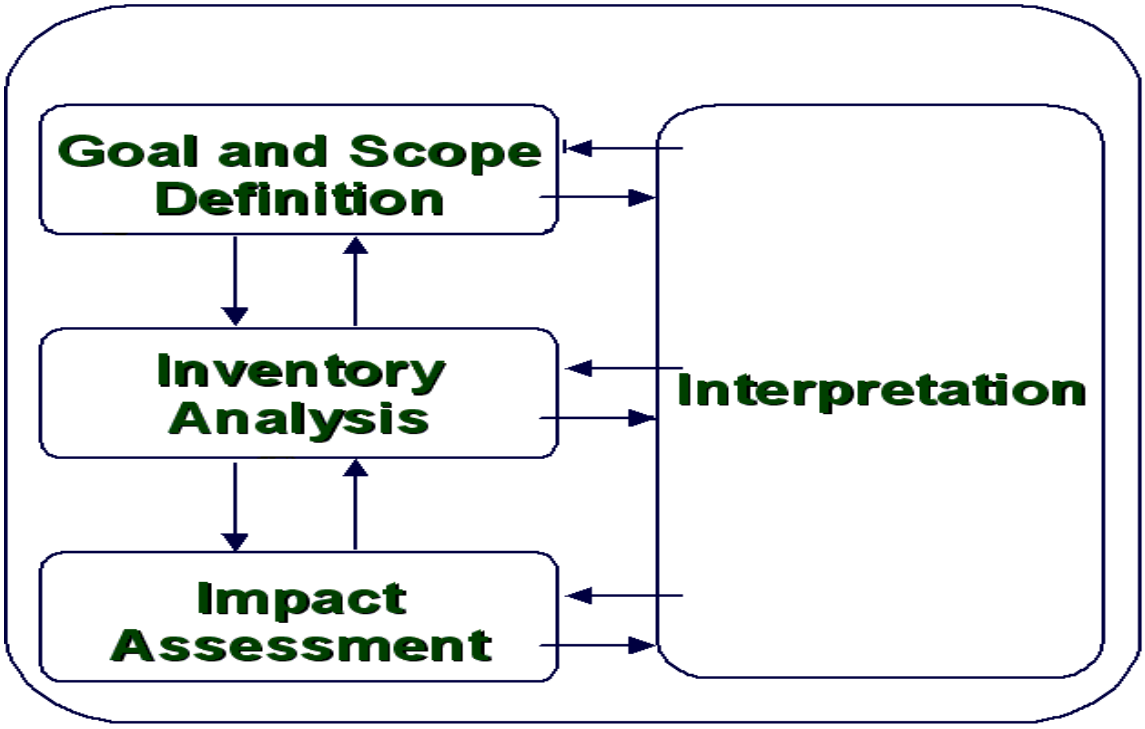
1. Goal Definition and Scoping - Define and describe the product, process or activity. Establish the context in which the assessment is to be made and identify the boundaries and environmental effects to be reviewed for the assessment.

2. Inventory Analysis - Identify and quantify energy, water and materials usage and environmental releases (e.g., air emissions, solid waste disposal, wastewater discharge).

3. Impact Assessment - Assess the human and ecological effects of energy, water, and material usage and the environmental releases identified in the inventory analysis.

4. Interpretation - Evaluate the results of the inventory analysis and impact assessment to select the preferred product, process or service with a clear understanding of the uncertainty and the assumptions used to generate the results.

**Figure 1-2 Phases of a LCA**




### 1.1 LIFE CYCLE ASSESSMENT MODELS

LCA work involves the collection and utilization of large amounts of data and thus is ideally suited to the use of computer models to assist with the inventorying and analysis of the data. In North America, two models are widely used for the analysis of transportation fuels:

- GREET. A model developed by Argonne National Laboratory in the United States, and
- GHGenius. A model developed by Natural Resources Canada, which has data for both Canada and the United States. This model also has much greater flexibility for modelling different types of crude oil production and many more types of alternative fuels.

The GHGenius model has been developed for Natural Resources Canada over the past eight years by S&T Squared Consultants Inc. It is based on the 1998 version of Dr. Mark Delucchi's Life Cycle Emissions Model (LEM). GHGenius is capable of analyzing the emissions of many contaminants associated with the production and use of traditional and alternative transportation fuels.

GHGenius is capable of estimating life cycle emissions of the primary greenhouse gases and the criteria pollutants from combustion sources. The specific gases that are included in the model include:

- Carbon dioxide ($CO_2$),
- Methane ($CH_4$),
- Nitrous oxide ($N_2O$),

- Chlorofluorocarbons (CFC-12),
- Hydro fluorocarbons (HFC-134a),
- The $CO_2$-equivalent of all of the contaminants above.
- Carbon monoxide (CO),
- Nitrogen oxides (NOx),
- Non-methane organic compounds (NMOCs), weighted by their ozone forming potential,
- Sulphur dioxide ($SO_2$),
- Total particulate matter.

The model is capable of analyzing the emissions from conventional and alternative fuelled internal combustion engines or fuel cells for light duty vehicles, for class 3-7 medium-duty trucks, for class 8 heavy-duty trucks, for urban buses and for a combination of buses and trucks, and for light duty battery powered electric vehicles. There are over 200 vehicle and fuel combinations possible with the model.

GHGenius can predict emissions for past, present and future years through to 2050 using historical data or correlations for changes in energy and process parameters with time that are stored in the model. The fuel cycle segments considered in the model are as follows:

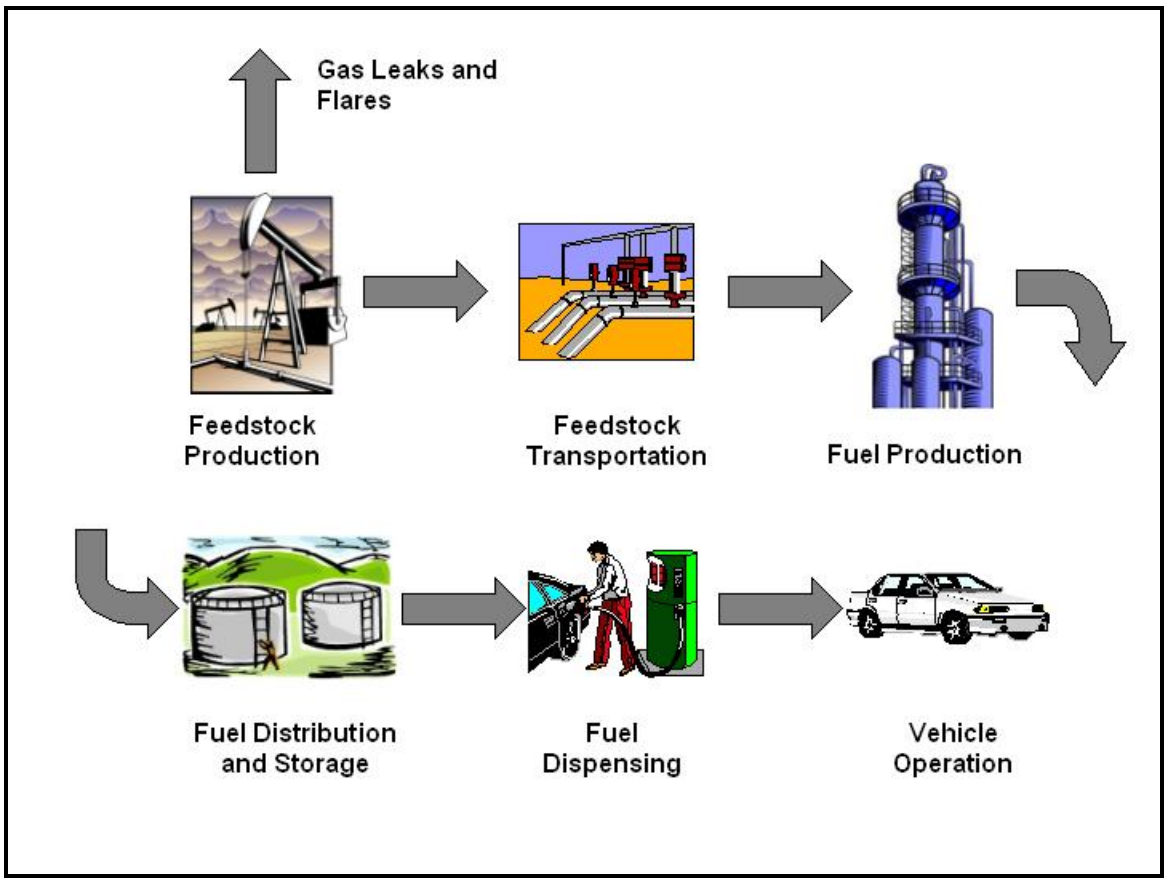
- Vehicle Operation
  Emissions associated with the use of the fuel in the vehicle. Includes all greenhouse gases.
- Fuel Dispensing at the Retail Level
  Emissions associated with the transfer of the fuel at a service station from storage into the vehicles. Includes electricity for pumping, fugitive emissions and spills.
- Fuel Storage and Distribution at all Stages
  Emissions associated with storage and handling of fuel products at terminals, bulk plants and service stations. Includes storage emissions, electricity for pumping, space heating and lighting.
- Fuel Production (as in production from raw materials)
  Direct and indirect emissions associated with conversion of the feedstock into a saleable fuel product. Includes process emissions, combustion emissions for process heat/steam, electricity generation, fugitive emissions and emissions from the life cycle of chemicals used for fuel production cycles.
- Feedstock Transport
  Direct and indirect emissions from transport of feedstock, including pumping, compression, leaks, fugitive emissions, and transportation from point of origin to the fuel refining plant. Import/export, transport distances and the modes of transport are considered.
- Feedstock Production and Recovery
  Direct and indirect emissions from recovery and processing of the raw feedstock, including fugitive emissions from storage, handling, upstream processing prior to transmission, and mining.
- Fertilizer Manufacture
  Direct and indirect life cycle emissions from fertilizers, and pesticides used for feedstock production, including raw material recovery, transport and manufacturing of chemicals. This is not included if there is no fertilizer associated with the fuel pathway.
- Land use changes and cultivation associated with biomass derived fuels

Emissions associated with the change in the land use in cultivation of crops, including $N_2O$ from application of fertilizer, changes in soil carbon and biomass, methane emissions from soil and energy used for land cultivation.

- Carbon in Fuel from Air
  Carbon dioxide emissions credit arising from use of a renewable carbon source that obtains carbon from the air.
- Leaks and flaring of greenhouse gases associated with production of oil and gas
  Fugitive hydrocarbon emissions and flaring emissions associated with oil and gas production.
- Emissions displaced by co-products of alternative fuels
  Emissions displaced by co-products of various pathways. System expansion is used to determine displacement ratios for co-products from biomass pathways.
- Vehicle assembly and transport
  Emissions associated with the manufacture and transport of the vehicle to the point of sale, amortized over the life of the vehicle.
- Materials used in the vehicles
  Emissions from the manufacture of the materials used to manufacture the vehicle, amortized over the life of the vehicle. Includes lube oil production and losses from air conditioning systems.

The stages of the "wells to wheels" lifecycle captured by GHGenius are shown in the following figure.

**Figure 1-3 GHGenius Life Cycle Stages**




## 1.2 SCOPE OF WORK

The scope of the work undertaken includes the use of two feedstocks, wood, and flax straw, to be pyrolysed in the Ensyn RTP™ system to produce bio-oil that would be utilized in thermal applications or as a fuel for use in a turbine to produce electricity. The wood feedstock is already included in GHGenius but the flax straw has been added to the model.

We have gathered input data on flax straw collection and transport and added it to the GHGenius model.

The modelling output includes energy use per unit of energy produced, the GHG emissions (g $CO_{2eq}$/unit of fuel produced), and other air contaminants. We have compared the results to both diesel fuel and natural gas in thermal applications and where the bio-oil is used to make electricity the emissions have been compared to electricity produced from coal, fuel oil, and natural gas. The fuel dispensing and vehicle operation stages of the lifecycle have not been added for this work as the fuel is used for non-vehicle applications.

A special version of GHGenius 3.14b has been created for this work. Two reports have been prepared, one for wood and one for flax straw. This is the report for wood.

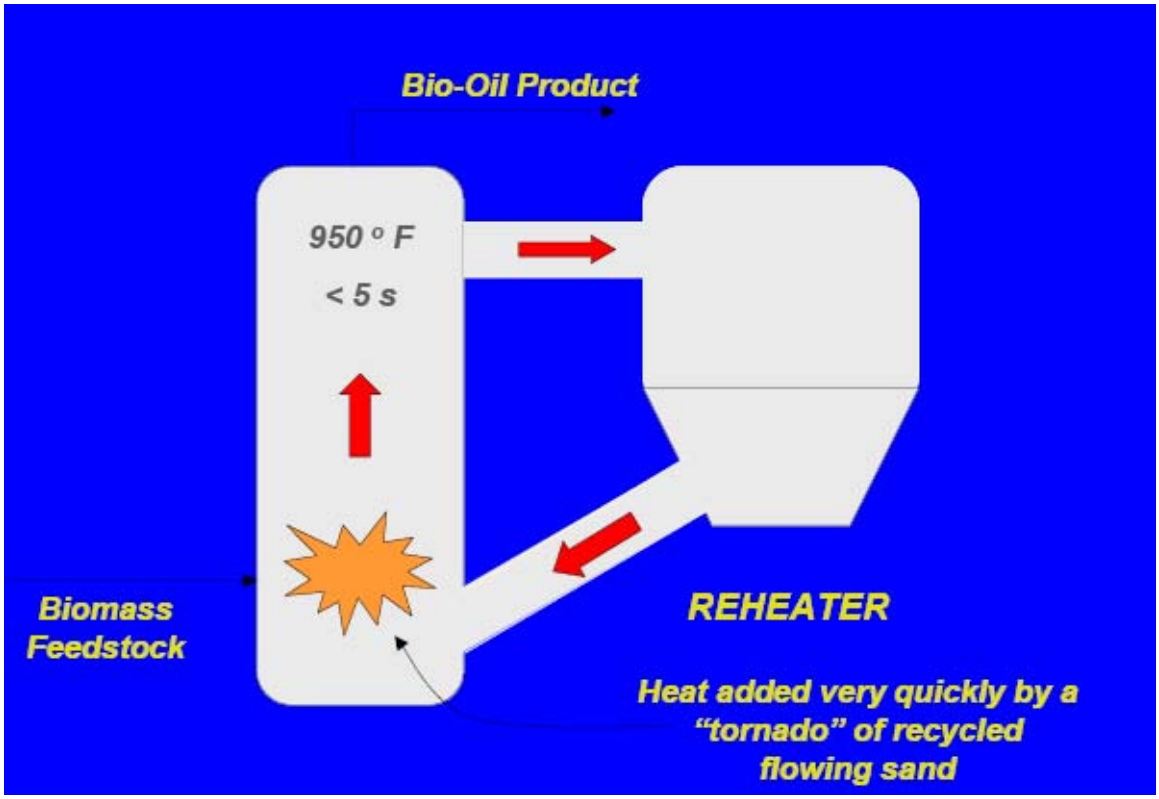
# 2. DESCRIPTION OF SYSTEM

Ensyn's Rapid Thermal Processing (RTP)™ technology, the world's only pyrolysis technology that has operated on a long-term commercial basis, converts biomass to liquid in less than two seconds.

RTP™ is a fast thermal process whereby biomass is introduced into a vessel and rapidly heated to 500ºC by a tornado of hot sand and then rapidly cooled within seconds. The process generates a relatively high yield (i.e., approx 75 wt%) of pourable, liquid "bio-oil" from residual forestry or agricultural biomass).

The process also produces by-product char and non-condensable gas, both of which can be efficiently used to provide process energy, which can then be used in the reheater to maintain the RTP™ process and/or in the dryer to condition the biomass. A simple flow scheme is shown in the following figure.

**Figure 2-1 Ensyn's RTP Process**




## 2.1 FEEDSTOCKS

Two feedstocks have been considered for this work, wood and flax straw. In both cases, the feedstocks are waste products and following normal LCA practice are deemed to be environmental burden free at the point of generation. This system boundary is discussed below for wood.

### 2.1.1 Wood Residues

Wood residues are already included in GHGenius, as is short rotation forestry. In the case of wood residues, it has been assumed that the wood residue is produced and consumed onsite. Any emissions attributable to the cutting of the tree, transporting it to a mill site, produce lumber or pulp, and generating the wood residue are attributable to the primary product being produced and not apportioned to the waste product. This is a standard practice in lifecycle assessment work.

### 2.1.2 Short Rotation Forestry

GHGenius can also model wood production from short rotation forestry. This pathway does include all of the material and energy inputs that are required to grow the trees, harvest them and transport them to a plant. The emissions from this resource are very dependent on the prior use of the land that the wood is grown on. The version of GHGenius that has been supplied for this work has the land use emissions "zeroed out", essentially meaning that it is assumed that the wood is grown on land that has always been used for short rotation forestry. A user can therefore switch back and forth between wood residues and short rotation forestry by just using a switch in cell B 141 on the Input Sheet. There are therefore two wood scenarios than can be modelled for bio-oil.

## 2.2 BIO-OIL PRODUCTION

If biomass is heated to high temperatures in the total absence of oxygen, it pyrolyzes to a liquid that is oxygenated, but otherwise has some similar characteristics to petroleum. This pyrolysis or "bio-oil" can be burned to generate heat or electricity or it can be used to provide base chemicals for biobased products.

The liquid contains varying quantities of water, which forms a stable single phase mixture, ranging from about 15 wt% to an upper limit of about 40 wt% water, depending on how it was produced and subsequently collected. It is immiscible with petroleum-derived fuels.

The density of the liquid is very high at around 1.2 kg/litre compared to light fuel oil at around 0.85 kg/ litre. This means that the liquid has about 42% of the energy content of fuel oil on a weight basis, but 61% on a volumetric basis.

The typical characteristics of bio-oil are summarized in the following table.

**Table 2-1 Bio-Oil Physical Properties**

| Physical Properties | Typical Value |
|---|---|
| Moisture content | 15–30% |
| pH | 2.5 |
| Specific gravity | 1.20 |
| Elemental analysis, dry basis | |
| C | 56.4% |
| H | 6.2% |
| O (by difference) | 37.3% |
| N | 0.1% |
| Ash | 0.1% |
| HHV as produced (depends on moisture) | 16–19 MJ/kg |
| Viscosity (at 40ºC and 25% water) | 40–100 cp |
| Solids (char) | 0.5% |
| Distillation | max. 50% as liquid degrades |

### 2.2.1 Mass and Energy Balance

Ensyn have supplied mass and energy balance information on their system for the two feedstocks of interest. This information for wood is summarized below.

#### *2.2.1.1 Wood Residues*

Most of the operating experience with the Ensyn system has been developed with systems that use wood as the feedstock. The pyrolysis process produces bio-oil, char, and a fuel gas form the wood feedstock. It has been assumed that the char and the fuel gas are utilized by the system to dry the feedstock and thus the overall system can be simplified to one that utilizes dry feedstock to produce bio-oil. The system uses some electricity and during start-up some natural gas. It has been assumed that the average energy requirements can be estimated based on 5% of the start-up values and 95% of the normal operating values. The energy balance includes the energy requirements for preparation of the feedstock. The inputs and outputs from the system are summarized in the following table.

**Table 2-2 System Inputs and Outputs - Wood**

| | Input | Output |
|---|---|---|
| Dry wood, kg | 1.372 | |
| Electric Power, kWh | 0.205 | |
| Natural gas, litres | 0.02 | |
| Bio-oil, kg | | 1.0 |

### 2.2.2 Process Emissions

There are emissions from the system that can also impact the lifecycle emissions of air contaminants and GHG emissions. These result from the wood drying and from the pyrolysis system itself.

The non-energy related process emissions are summarized in the following table. These are estimated from emission test results on the produced char when available and otherwise from estimates of wood combustion systems. In GHGenius, these emissions are reported per unit of feedstock and not per unit of feedstock combusted. In the case of the Ensyn system, about 20% of the feedstock is combusted as char with much of the remaining material producing the bio-oil. The appropriate adjustment has been made to the input data.

**Table 2-3 Process Emissions - Wood**

| Component | Emissions g/GJ of Feedstock |
|---|---|
| Aldehydes (as HCHO) exhaust | 0.10 |
| NMOC exhaust | 2.00 |
| $CH_4$ (exhaust) | 0.40 |
| CO | 2.20 |
| $N_20$ | 0.50 |
| NOx ($NO_2$) | 11.0 |
| SOx ($SO_2$) | 0.0 |
| PM | 5.00 |

## 2.3 BIO-OIL UTILIZATION

For this work it has been assumed that the bio-oil could be used in thermal applications as a replacement for heating oil or natural gas and in a turbine for the production of electric power.

### 2.3.1 Thermal Applications

It will be assumed that the combustion efficiency of the bio-oil is the same as that of heating oil. The emissions from the combustion of bio-oil required for the model are summarized in the following table. These are based on emission test results supplied by Ensyn. The SOx emissions are calculated from the sulphur content of the fuel. In cases where the Ensyn results did not report results for a parameter, the emissions have been estimated from the parameters that are reported and emission factors for fuel oil.

**Table 2-4 Combustion Emissions – Bio-oil**

| Component | Emissions g/GJ of Fuel |
|---|---|
| Aldehydes (as HCHO) exhaust | 0.00 |
| Fuel evaporation or leakage | 0.00 |
| NMOC exhaust | 0.09 |
| $CH_4$ | 0.05 |
| CO | 15.51 |
| $N_20$ | 0.32 |
| NOx ($NO_2$) | 160.3 |
| SOx ($SO_2$) | 0.89 |
| PM | 23.8 |

### 2.3.2 Electricity Production

The emissions from the combustion of the bio-oil in a turbine are summarized in the following table. The emission factors for CO, NOx, and SOx have been supplied by Ensyn and are based on test results. The other emission factors are based on typical results for an oil-fired turbine (EPA AP-42, and IPCC).

**Table 2-5 Combustion Turbine Emissions – Bio-oil**

| Component | Emissions g/GJ of Fuel |
|---|---|
| Aldehydes (as HCHO) exhaust | 0.12 |
| NMOC exhaust | 0.43 |
| $CH_4$ (exhaust) | 0.1 |
| CO | 100 |
| $N_20$ | 0.3 |
| NOx ($NO_2$) | 120 |
| SOx ($SO_2$) | 4 |
| PM | 5 |

We have modelled a net power system efficiency of 29.6%. The user of the model can easily change this by changing the value in cell L32 on sheet J.

# 3. BIO-OIL RESULTS

The energy balance results and the lifecycle GHG emissions for the various scenarios modelled are presented in this section along with values for some fossil energy equivalents for comparison. The GHGenius model is set to 2009 and it is assumed that the bio-oil is produced and used in Alberta.

## 3.1 ENERGY BALANCE

GHGenius can calculate the total energy balance for a pathway or the fossil energy balance. These balances include all of the energy used to make the various secondary energy sources used in a process.

### 3.1.1 Wood Feedstock

In the following table the total energy balance for wood residues and short rotation forestry are compared to the energy balance for heating oil and natural gas.

**Table 3-1 Total Energy Balance – Wood Feedstocks**

| Fuel | Heating oil | Natural Gas | Bio-oil | Bio-oil |
|---|---|---|---|---|
| Feedstock | Crude Oil | Natural Gas | Wood residues | Short Rotation Forestry |
| | Joules Consumed/Joule Delivered | | | |
| Fuel dispensing | 0.0041 | 0.0000 | 0.0108 | 0.0108 |
| Fuel distribution, storage | 0.0082 | 0.0306 | 0.0049 | 0.0049 |
| Fuel production | 0.1229 | 0.0257 | 0.7899 | 0.7899 |
| Feedstock transmission | 0.0148 | 0.0000 | 0.0000 | 0.0161 |
| Feedstock recovery | 0.1241 | 0.0292 | 0.0000 | 0.0365 |
| Ag. chemical manufacture | 0.0000 | 0.0000 | 0.0000 | 0.0252 |
| Co-product credits | -0.0013 | 0.0000 | 0.0000 | 0.0000 |
| Total | **0.2729** | **0.0855** | **0.8057** | **0.8834** |
| Net Energy Ratio (J delivered/J consumed) | **3.6646** | **11.6911** | **1.2412** | **1.1319** |

The bio-oil systems do require more total energy to produce a unit of energy than producing heating oil or natural gas does. This situation changes when the fossil energy requirements are considered as shown in the following table. The energy balance for the bio-oil produced from wood is quite good.

**Table 3-2 Fossil Energy Balance– Wood Feedstocks**

| Fuel | Heating oil | Natural Gas | Bio-oil | Bio-oil |
|---|---|---|---|---|
| Feedstock | Crude Oil | Natural Gas | Wood residues | Short Rotation Forestry |
| | Joules Consumed/Joule Delivered | | | |
| Fuel dispensing | 0.0038 | 0.0000 | 0.0099 | 0.0099 |
| Fuel distribution, storage | 0.0079 | 0.0305 | 0.0048 | 0.0048 |
| Fuel production | 0.1217 | 0.0254 | 0.0884 | 0.0884 |
| Feedstock transmission | 0.0144 | 0.0000 | 0.0000 | 0.0160 |
| Feedstock recovery | 0.1221 | 0.0286 | 0.0000 | 0.0362 |
| Ag. chemical manufacture | 0.0000 | 0.0000 | 0.0000 | 0.0250 |
| Co-product credits | -0.0013 | 0.0000 | 0.0000 | 0.0000 |
| Total | **0.2686** | **0.0846** | **0.1031** | **0.1803** |
| Net Energy Ratio (J delivered/J consumed) | **3.7224** | **11.8230** | **9.6985** | **5.5458** |

### 3.2 GHG EMISSIONS

The GHG emissions for the production and use of bio-oil in a thermal application are calculated by GHGenius for each stage in the production process.

#### 3.2.1 Wood Feedstock

The GHG emissions for the two wood feedstocks are presented in the following table and compared to those of heating oil and natural gas. Since the primary source of the GHG emissions is the electric power that is required for the system, the emissions will vary by province depending on the carbon intensity of the electric power in each region. The bio-oil produced from the two wood feedstocks provide significant reductions in GHG emissions compared to either heating oil or natural gas.

**Table 3-3 GHG Emissions – Wood Feedstock**

| Fuel | Heating oil | Natural Gas | Bio-oil | Bio-oil |
|---|---|---|---|---|
| Feedstock | Crude Oil | Natural Gas | Wood residues | Short Rotation Forestry |
| | g $CO_{2eq}$/GJ | | | |
| Fuel dispensing | 402 | 0 | 874 | 875 |
| Fuel distribution and storage | 698 | 2,063 | 361 | 362 |
| Fuel production | 8,412 | 1,376 | 9,555 | 9,570 |
| Feedstock transmission | 1,401 | 0 | 0 | 1,264 |
| Feedstock recovery | 8,081 | 1,708 | 0 | 3,889 |
| Land-use changes, cultivation | 25 | 0 | 0 | 3,189 |
| Fertilizer manufacture | 0 | 0 | 0 | 1,475 |
| Gas leaks and flares | 1,900 | 3,540 | 0 | 0 |
| $CO_2$, $H_2S$ removed from NG | 0 | 642 | 0 | 0 |
| Emissions displaced | -128 | 0 | 0 | 0 |
| **Sub-Total Fuel production** | 20,790 | 9,330 | 10,790 | 20,623 |
| Fuel Combustion | 68,718 | 50,432 | 301 | 301 |
| **Grand Total** | **89,508** | **60,762** | **11,091** | **20,924** |
| % Change compared to heating oil | | -32.1% | -87.6% | -76.6% |

# 4. ELECTRICITY RESULTS

The bio-oil produced can be combusted in a turbine generator set to produce electric power and the emissions intensity of this pathway is compared to other thermal generation options in this section.

## 4.1 POWER GENERATION EMISSIONS

The GHG emissions of the wood to bio-oil to electric power pathways are summarized in the following table. The two wood scenarios have an emission intensity 74 to 86% less than a coal fired power plant.

**Table 4-1 GHG Emissions from Power Generation - Wood**

| | Coal | Fuel oil | NG/boiler | NG turbine | Bio-oil | |
|---|---|---|---|---|---|---|
| | | | | | Wood Residues | Wood SRF |
| | g/GJ-input | | | | | |
| Aldehydes | 0.05 | 0.12 | 0.00 | 0.00 | 0.41 | 0.41 |
| NMOC | 1.31 | 2.18 | 3.69 | 0.65 | 1.45 | 1.45 |
| Ozone-weighted NMOC | 0.85 | 1.09 | 1.47 | 0.26 | 0.73 | 0.73 |
| $CH_4$ | 0.87 | 0.80 | 0.97 | 3.70 | 0.34 | 0.34 |
| CO | 10.88 | 14.37 | 35.58 | 35.29 | 337.84 | 337.84 |
| $N_2O$ | 0.04 | 0.01 | 0.04 | 1.29 | 1.01 | 1.01 |
| NOx as $NO_2$ | 237.73 | 65.15 | 59.73 | 69.35 | 405.41 | 405.41 |
| SOx | 688 | 305 | 0.62 | 0.62 | 13.51 | 13.51 |
| PM | 21.78 | 12.43 | 3.22 | 2.84 | 16.89 | 16.89 |
| $CO_2$ from combustion | 90,378 | 71,101 | 50,066 | 50,069 | 0 | 0 |
| All other gases from combustion | 36 | 31 | 46 | 479 | 313 | 313 |
| Subtotal from combustion | 90,413 | 71,132 | 50,112 | 50,548 | 313 | 313 |
| Upstream fuelcycle emissions | 3,008 | 14,738 | 6,250 | 6,250 | 10,790 | 20,623 |
| **Total fuelcycle emissions** | | | | | | |
| g-$CO_2$-eq/GJ-generated | 274,768 | 250,755 | 156,592 | 106,070 | 37,508 | 70,729 |
| Distribution efficiency | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| g-$N_2O$/kWh-delivered | 0 | 0 | 0 | 0 | 0.01 | 0.01 |
| g-$CO_2$-eq of SF6/GJ-generated | 561 | 561 | 561 | 561 | 561 | 561 |
| g-$CO_2$-eq/GJ-delivered | 299,808 | 273,735 | 171,496 | 116,640 | 42,196 | 78,267 |
| g-$CO_2$-eq/kWh-delivered | 1,079.3 | 985.4 | 617.4 | 419.9 | 151.9 | 281.8 |
| % change vs. coal plant | n.a. | -8.7% | -42.8% | -61.1% | -86.0% | -74.0% |

# 5. DISCUSSION

The production of bio-oil in an Ensyn RTP™ system yields a liquid fuel that can be stored and transported much like conventional petroleum products. This fuel can be used as a replacement for heating oil or natural gas in stationary power applications. It can also be used in turbine generator systems to produce electricity. In each of the cases that were investigated the bio-oil system produces significant GHG emission reductions compared to the use of fossil fuels.

There are a number of different ways that the electricity production system could have been modelled. The approach used here was to calculate the emissions on a gross basis, where purchased electricity is used to operate the system and the emissions are calculated based on including those emissions in the emissions required to produce the electricity from the system. Another approach would be to look at the system on a net basis, where no electric power is purchased but the electric power produced would be a net amount after accounting for the system use. The GHG emissions on a per kWh delivered basis would be significantly lower with this approach, but not as much power would be available for sale.

In the case of the wood residue scenario, 86% of the GHG emissions associated with producing the bio-oil are associated with the electric power consumed by the system and thus if these are supplied by the system itself the overall GHG emissions will be much lower. The GHG emission intensity of the electric power produced by the system would be 97% less than coal fired if calculated on a net basis, rather than a gross basis as shown in the previous tables.

GHGenius also calculate the CAC emissions on a lifecycle basis. These emissions for the production of the fuel are shown in the following table. The values are in addition to the emissions created from the combustion of the fuel. In the case of the Ensyn bio-oil most of the emissions are associated with the production of electricity that is consumed in the process.

**Table 5-1 Criteria Air Emissions**

| | Heating oil | Natural Gas | Bio-oil | Bio-oil |
|---|---|---|---|---|
| | Crude Oil | Natural Gas | Wood residues | Short Rotation Forestry |
| | g/GJ | | | |
| Carbon dioxide ($CO_2$) | 18,079 | 5,009 | 10,248 | 16,426 |
| Non methane organic compounds (NMOCs) | 10 | 4 | 2 | 4 |
| Methane ($CH_4$) | 98 | 171 | 10 | 24 |
| Carbon monoxide (CO) | 16 | 8 | 7 | 64 |
| Nitrous oxide ($N_2O$) | 1 | 0 | 1 | 12 |
| Nitrogen oxides ($NO_2$) | 72 | 37 | 43 | 122 |
| Sulphur oxides (SOx) | 66 | 8 | 64 | 73 |
| Particulate matter (PM) | 6 | 0 | 10 | 13 |
| HFC-134a (mg) | 0 | 0 | 0 | 2 |
| $CO_2$-equivalent GHG emissions | 20,790 | 9,330 | 10,790 | 20,623 |

The emissions associated with the wood residue case compare favourable to the reference cases of heating oil and natural gas. The emissions of the short rotation forestry case are generally higher and reflect the additional emissions associated with some fertilizer production and application and the emissions associated with removing the biomass from the forest.

# 6. REFERENCES

EPA. AP-42. Stationary Gas Turbines.
http://www.epa.gov/ttnchie1/ap42/ch03/final/c03s01.pdf

IPCC. 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html

# Appendix D

HPUL Priority Climate Action Plan Survey

# Habematolel Pomo of Upper Lake Priority Climate Action Plan Tribal Survey

Our Tribe is developing the HPUL Priority Climate Action Plan as a strategic roadmap that empowers our Tribe to build climate resilience and strive for a more sustainable future. The plan will include actions impacted by and related to transportation, energy, buildings, resiliency, adaptation, and public health.

This survey introduces the Tribe to a number of climate and resiliency ideas and allows you to consider the impacts of these ideas in our community, both today and in the future. Your time and consideration of the questions below will help us understand our Tribe's climate and resiliency needs and will help guide the creation of the HPUL Priority Climate Action Plan. We appreciate your participation.

This is the standard EPA community survey.  Some of the questions may seem inapplicable, but your answers will demonstrate our Tribe's priorities regarding climate change.  The survey will take approximately 10 minutes to complete, and your response is confidential. Thank you for your participation!

* Indicates required question

You can also take this survey on your mobile device by scanning the QR code

1. Tribal Member Name *

2. How much do you agree or disagree with the following statement: "I am informed about climate change.

   *Mark only one oval.*

   - ◯ Strongly disagree
   - ◯ Disagree
   - ◯ Neutral
   - ◯ Agree
   - ◯ Strongly agree

3. Is it important for the Tribe to prepare for the impacts of climate change?

   *Mark only one oval.*

   - ◯ It is not important
   - ◯ It is not as important as other issues we are facing
   - ◯ Not sure
   - ◯ It is important
   - ◯ Preparing for climate change is critical

4. Which of the following conditions have you observed or experienced? Select all that apply

*Check all that apply.*

- [ ] More severe weather events (quick/drastic weather changes, extreme weather events)
- [ ] Longer/more severe droughts
- [ ] Higher temperatures (extreme heat and/or duration of heat events)
- [ ] Low temperatures (extreme lows and/or duration of cold snaps)
- [ ] Season shifts (longer spring/summer, later fall/winter)
- [ ] Warmer water temperatures in rivers and lakes
- [ ] Longer/more intense buggy seasons (ticks, mosquitos)
- [ ] Longer/more intense allergy seasons
- [ ] Reduced/impacted air quality
- [ ] Flooding as a result of weather events
- [ ] Wildfires
- [ ] Erosion and soil instability
- [ ] I haven't seen or experienced or observed any of these events.

5. Have any of the following conditions impacted you, your family, or your neighborhood as a result of climate-related events? Select all that apply.

*Check all that apply.*

- [ ] Flooding/Flood damage
- [ ] Wildfire damage
- [ ] Property damage due to wind/storm impacts (wind, hail, erosion, water)
- [ ] Crop/vegetation/tree loss due to drought
- [ ] Heat stroke or Hyperthermia
- [ ] Increased respiratory illnesses: duration and/or severity (asthma)
- [ ] More severe and/or longer impacts of allergies
- [ ] Breathing/vision impacts due to poor air quality
- [ ] Illness from mosquitos/ticks
- [ ] Change or loss of local wildlife (impacts to hunting, fishing, enjoyment of the outdoors)
- [ ] Tree damage/loss due to insect infestation
- [ ] Increased energy costs (cooling and/or heating costs)
- [ ] Increased insurance costs
- [ ] None of these conditions have impacted me, my family, or my neighborhood

6. How would you rate the impacts of climate change on Tribal community health and welfare?

*Mark only one oval.*

- ◯ No impacts
- ◯ Slight impacts
- ◯ Moderate impacts
- ◯ Major impacts

7. How would you rate the impacts of climate change on public services and goods (e.g., roads, bridges, water, sewer, power, and internet)?

*Mark only one oval.*

- No impacts
- Slight impacts
- Moderate impacts
- Major impacts

8. How concerned are you with the effects of climate change regarding public health and welfare?

*Mark only one oval.*

- Not concerned
- Slightly concerned
- Moderately concerned
- Very concerned

9. How concerned are you with the effects of climate change regarding public services and goods (e.g., roads, bridges, water, sewer, power, and internet)?

*Mark only one oval.*

- Not concerned
- Slightly concerned
- Moderately concerned
- Very concerned

10. How concerned are you with the effects of climate change regarding local ecosystems (e.g., plant and animal life)?

*Mark only one oval.*

- ◯ Not concerned
- ◯ Slightly concerned
- ◯ Moderately concerned
- ◯ Very concerned

## Transportation

How would you prioritize the following actions as related to transportation and climate change?

11. Increase the number of people using public transit

*Mark only one oval.*

- ◯ Not a priority
- ◯ Low priority
- ◯ Moderate priority
- ◯ High priority
- ◯ Top priority

12. Expand public transit options

*Mark only one oval.*

- Not a priority
- Low priority
- Moderate priority
- High priority
- Top priority

13. Encourage the use of shared mobility options (bike share, carpooling, ride share)

*Mark only one oval.*

- Not a priority
- Low priority
- Moderate priority
- High priority
- Top priority

14. Expand the number of electric vehicle (EV) charging stations (public and private options)

*Mark only one oval.*

- Not a priority
- Low priority
- Moderate priority
- High priority
- Top priority

15. Replace gas-powered vehicles with electric vehicles in the Tribal fleet

*Mark only one oval.*

- ◯ Not a priority
- ◯ Low priority
- ◯ Moderate priority
- ◯ High priority
- ◯ Top priority

## Buildings and Energy

How would you prioritize the following actions as related to buildings/energy and climate change?

16. Develop more access to and encourage alternative energy systems (solar, wind, etc.)

*Mark only one oval.*

- ◯ Not a priority
- ◯ Low priority
- ◯ Moderate priority
- ◯ High priority
- ◯ Top priority

17. Adopt energy efficiency standards in buildings

*Mark only one oval.*

- Not a priority
- Low priority
- Moderate priority
- High priority
- Top priority

18. Prioritize clean energy job creation

*Mark only one oval.*

- Not a priority
- Low priority
- Moderate priority
- High priority
- Top priority

19. Prioritize renewable energy sources that convert forest floor materials (forest slash) into biofuels while also mitigating forest fire risk

*Mark only one oval.*

- Not a priority
- Low priority
- Moderate priority
- High priority
- Top priority

## Waste Management

How would you prioritize the following actions as related to waste management?

20. Make recycling easier and more accessible

*Mark only one oval.*

- ◯ Not a priority
- ◯ Low priority
- ◯ Moderate priority
- ◯ High priority
- ◯ Top priority

21. Reduce waste generated by the Tribal government and Tribal businesses

*Mark only one oval.*

- ◯ Not a priority
- ◯ Low priority
- ◯ Moderate priority
- ◯ High priority
- ◯ Top priority

22. Implement composting programs for Tribal members and Tribal businesses

*Mark only one oval.*

- Not a priority
- Low priority
- Moderate priority
- High priority
- Top priority

23. Reduce littering and illegal dumping

*Mark only one oval.*

- Not a priority
- Low priority
- Moderate priority
- High priority
- Top priority

24. Implement programs to target reductions in commercial waste

*Mark only one oval.*

- Not a priority
- Low priority
- Moderate priority
- High priority
- Top priority

## Ecosystem Resiliency and Adaptation

How would you prioritize the following actions as related to ecosystem resiliency and adaptation?

25. Inclusion of climate risk and environmental impact review in Tribal planning and decision making

*Mark only one oval.*

- ◯ Not a priority
- ◯ Low priority
- ◯ Moderate priority
- ◯ High priority
- ◯ Top priority

26. Plant more trees

*Mark only one oval.*

- ◯ Not a priority
- ◯ Low priority
- ◯ Moderate priority
- ◯ High priority
- ◯ Top priority

27. Develop conservation/preservation programs for lakes, waterways, and other ecologically sensitive areas

*Mark only one oval.*

- Not a priority
- Low priority
- Moderate priority
- High priority
- Top priority

28. Develop programs designed to protect area pollinator species

*Mark only one oval.*

- Not a priority
- Low priority
- Moderate priority
- High priority
- Top priority

29. Develop programs to reduce forest slash to mitigate the risk of wild fire

*Mark only one oval.*

- Not a priority
- Low priority
- Moderate priority
- High priority
- Top priority

## Public Health

How would you prioritize the following actions as related to the public health of the Tribal community?

30. Provide cooling and heating centers during extreme temperature events

*Mark only one oval.*

- ◯ Not a priority
- ◯ Low priority
- ◯ Moderate priority
- ◯ High priority
- ◯ Top priority

31. Create programs to address airborne pollutants and emerging air quality issues

*Mark only one oval.*

- ◯ Not a priority
- ◯ Low priority
- ◯ Moderate priority
- ◯ High priority
- ◯ Top priority

32. Maintaining access to clean water and improving water quality

*Mark only one oval.*

- Not a priority
- Low priority
- Moderate priority
- High priority
- Top priority

33. Ensure access to adequate food sources for all

*Mark only one oval.*

- Not a priority
- Low priority
- Moderate priority
- High priority
- Top priority

34. Examine the impact of extreme weather events on disaster response, access to critical services, transportation, housing, and recovery services

*Mark only one oval.*

- Not a priority
- Low priority
- Moderate priority
- High priority
- Top priority

35. Implement programs to teach Climate and Resilience Health Awareness

*Mark only one oval.*

- Not a priority
- Low priority
- Moderate priority
- High priority
- Top priority

## Tribal Member Ideas/Feedback

Is there something we missed? What other ideas, questions, comments or concerns do you have regarding the development of the Tribe's Priority Climate Action Plan?

36. Ideas, questions, comments or concerns (please detail below)

Thank you for your participation in this survey.
Your input is very valuable and will be used in the development of the Tribe's Priority Climate Action Plan

| Timestamp | Tribal Member Name | How much do you agree or disagree with the following statement: "I am informed about climate change. | Is it important for the Tribe to prepare for the impacts of climate change? | Which of the following conditions have you observed or experienced? Select all that apply |
|---|---|---|---|---|
| 12/2/2023 14:17:35 | | Agree | Preparing for climate change is critical | More severe weather events (quick/drastic weather changes, extreme weather events), Longer/more severe droughts, Higher temperatures (extreme heat and/or duration of heat events), Low temperatures (extreme lows and/or duration of cold snaps), Season shifts (longer sprin |
| 12/6/2023 16:29:07 | | Strongly disagree | It is important | More severe weather events (quick/drastic weather changes, extreme weather events), Longer/more severe droughts, Higher temperatures (extreme heat and/or duration of heat events), Season shifts (longer spring/summer, later fall/winter), Longer/more intense allergy season |
| 12/2/2023 14:11:32 | | Strongly agree | Preparing for climate change is critical | More severe weather events (quick/drastic weather changes, extreme weather events), Longer/more severe droughts, Higher temperatures (extreme heat and/or duration of heat events), Low temperatures (extreme lows and/or duration of cold snaps), Season shifts (longer sprin |
| 12/2/2023 14:10:28 | | Agree | It is important | More severe weather events (quick/drastic weather changes, extreme weather events), Low temperatures (extreme lows and/or duration of cold snaps), Longer/more intense buggy seasons (ticks, mosquitos), Longer/more intense allergy seasons, Flooding as a result of weathe |
| 12/3/2023 15:11:02 | | Agree | It is important | Longer/more severe droughts, Higher temperatures (extreme heat and/or duration of heat events), Season shifts (longer spring/summer, later fall/winter), Reduced/impacted air quality, Flooding as a result of weather events, Wildfires |
| 12/2/2023 14:08:00 | | Strongly agree | Preparing for climate change is critical | More severe weather events (quick/drastic weather changes, extreme weather events), Longer/more severe droughts, Higher temperatures (extreme heat and/or duration of heat events), Low temperatures (extreme lows and/or duration of cold snaps), Season shifts (longer sprin |
| 12/2/2023 14:11:04 | | Neutral | Preparing for climate change is critical | More severe weather events (quick/drastic weather changes, extreme weather events), Higher temperatures (extreme heat and/or duration of heat events), Longer/more intense buggy seasons (ticks, mosquitos), Longer/more intense allergy seasons, Wildfires |
| 12/5/2023 10:47:07 | | Agree | Preparing for climate change is critical | More severe weather events (quick/drastic weather changes, extreme weather events), Longer/more severe droughts, Higher temperatures (extreme heat and/or duration of heat events), Flooding as a result of weather events, Wildfires |
| 12/2/2023 14:13:14 | | Agree | It is not as important as other issues we are facing | I haven't seen or experienced or observed any of these events. |
| 12/2/2023 14:21:51 | | Agree | It is not as important as other issues we are facing | Warmer water temperatures in rivers and lakes, Longer/more intense allergy seasons |
| 12/6/2023 16:23:16 | | Strongly agree | Preparing for climate change is critical | More severe weather events (quick/drastic weather changes, extreme weather events), Longer/more severe droughts, Higher temperatures (extreme heat and/or duration of heat events), Season shifts (longer spring/summer, later fall/winter), Warmer water temperatures in river |
| 12/4/2023 14:27:47 | | Strongly agree | It is important | More severe weather events (quick/drastic weather changes, extreme weather events), Longer/more severe droughts, Higher temperatures (extreme heat and/or duration of heat events), Low temperatures (extreme lows and/or duration of cold snaps), Season shifts (longer sprin |
| 12/2/2023 14:07:47 | | Neutral | Preparing for climate change is critical | More severe weather events (quick/drastic weather changes, extreme weather events), Longer/more intense allergy seasons, Flooding as a result of weather events, Wildfires |
| 12/2/2023 14:12:41 | | Neutral | It is important | More severe weather events (quick/drastic weather changes, extreme weather events), Longer/more severe droughts, Higher temperatures (extreme heat and/or duration of heat events), Low temperatures (extreme lows and/or duration of cold snaps), Longer/more intense allerg |
| 12/4/2023 14:26:49 | | Strongly agree | Preparing for climate change is critical | More severe weather events (quick/drastic weather changes, extreme weather events), Higher temperatures (extreme heat and/or duration of heat events), Reduced/impacted air quality, Wildfires |
| 12/2/2023 14:38:50 | | Neutral | Preparing for climate change is critical | More severe weather events (quick/drastic weather changes, extreme weather events), Longer/more severe droughts, Higher temperatures (extreme heat and/or duration of heat events), Low temperatures (extreme lows and/or duration of cold snaps), Season shifts (longer sprin |
| 12/2/2023 16:02:48 | | Agree | Preparing for climate change is critical | More severe weather events (quick/drastic weather changes, extreme weather events), Longer/more severe droughts, Higher temperatures (extreme heat and/or duration of heat events), Low temperatures (extreme lows and/or duration of cold snaps), Season shifts (longer sprin |
| 12/21/2023 13:15:17 | | Agree | Preparing for climate change is critical | Longer/more severe droughts, Higher temperatures (extreme heat and/or duration of heat events), Longer/more intense allergy seasons, Reduced/impacted air quality, Wildfires |
| 12/2/2023 14:14:58 | | Strongly agree | Preparing for climate change is critical | More severe weather events (quick/drastic weather changes, extreme weather events), Season shifts (longer spring/summer, later fall/winter), Flooding as a result of weather events |
| 12/2/2023 14:53:50 | | Neutral | Preparing for climate change is critical | More severe weather events (quick/drastic weather changes, extreme weather events), Longer/more severe droughts, Higher temperatures (extreme heat and/or duration of heat events), Low temperatures (extreme lows and/or duration of cold snaps), Season shifts (longer sprin |
| 12/2/2023 14:12:02 | | Agree | Preparing for climate change is critical | More severe weather events (quick/drastic weather changes, extreme weather events), Longer/more severe droughts, Higher temperatures (extreme heat and/or duration of heat events), Low temperatures (extreme lows and/or duration of cold snaps), Season shifts (longer sprin |
| 12/2/2023 14:07:57 | | Agree | Preparing for climate change is critical | Longer/more severe droughts, Longer/more intense buggy seasons (ticks, mosquitos), Longer/more intense allergy seasons, Reduced/impacted air quality, Wildfires |
| 12/6/2023 16:14:02 | | Strongly agree | Preparing for climate change is critical | More severe weather events (quick/drastic weather changes, extreme weather events), Longer/more severe droughts, Higher temperatures (extreme heat and/or duration of heat events), Low temperatures (extreme lows and/or duration of cold snaps), Season shifts (longer sprin |

| Have any of the following conditions impacted you, your family, or your neighborhood as a result of climate-related events? Select all that apply. | How would you rate the impacts of climate change on Tribal community health and welfare? | How would you rate the impacts of climate change on public services and goods (e.g., roads, bri |
|---|---|---|
| Wildfire damage, Property damage due to wind/storm impacts (wind, hail, erosion, water), Increased respiratory illnesses: duration and/or severity (asthma), More severe and/or longer impacts of allergies, Breathing/vision impacts due to poor air quality, Change or loss of local wildlife (impacts to hunting, fishing, enjoy | Major impacts | Moderate impacts |
| Flooding/Flood damage, Wildfire damage, Property damage due to wind/storm impacts (wind, hail, erosion, water), More severe and/or longer impacts of allergies, Tree damage/loss due to insect infestation, Increased energy costs (cooling and/or heating costs), Increased insurance costs | Major impacts | Major impacts |
| Flooding/Flood damage, Wildfire damage, Property damage due to wind/storm impacts (wind, hail, erosion, water), Breathing/vision impacts due to poor air quality, Tree damage/loss due to insect infestation, Increased insurance costs | Major impacts | Moderate impacts |
| Flooding/Flood damage, Wildfire damage, Property damage due to wind/storm impacts (wind, hail, erosion, water), Heat stroke or Hyperthermia, Increased respiratory illnesses: duration and/or severity (asthma), More severe and/or longer impacts of allergies, Breathing/vision impacts due to poor air quality, Illness fro | Major impacts | Major impacts |
| Flooding/Flood damage, Property damage due to wind/storm impacts (wind, hail, erosion, water), More severe and/or longer impacts of allergies, Increased energy costs (cooling and/or heating costs), Increased insurance costs | Major impacts | Major impacts |
| Wildfire damage, Increased respiratory illnesses: duration and/or severity (asthma), More severe and/or longer impacts of allergies, Change or loss of local wildlife (impacts to hunting, fishing, enjoyment of the outdoors), Tree damage/loss due to insect infestation, Increased energy costs (cooling and/or heating costs), | Moderate impacts | Major impacts |
| Property damage due to wind/storm impacts (wind, hail, erosion, water), Breathing/vision impacts due to poor air quality, Increased energy costs (cooling and/or heating costs), Increased insurance costs | Major impacts | Major impacts |
| Flooding/Flood damage, Property damage due to wind/storm impacts (wind, hail, erosion, water), Tree damage/loss due to insect infestation, Increased energy costs (cooling and/or heating costs), Increased insurance costs | Major impacts | Major impacts |
| None of these conditions have impacted me, my family, or my neighborhood | No impacts | No impacts |
| Increased insurance costs | Slight impacts | Slight impacts |
| Flooding/Flood damage, Wildfire damage, Crop/vegetation/tree loss due to drought, More severe and/or longer impacts of allergies, Breathing/vision impacts due to poor air quality, Change or loss of local wildlife (impacts to hunting, fishing, enjoyment of the outdoors), Increased energy costs (cooling and/or heating co | Major impacts | Major impacts |
| Wildfire damage, Breathing/vision impacts due to poor air quality, Increased energy costs (cooling and/or heating costs) | Major impacts | Major impacts |
| Wildfire damage, Breathing/vision impacts due to poor air quality, Increased energy costs (cooling and/or heating costs) | Moderate impacts | Moderate impacts |
| Flooding/Flood damage, Wildfire damage, Property damage due to wind/storm impacts (wind, hail, erosion, water), Increased respiratory illnesses: duration and/or severity (asthma), More severe and/or longer impacts of allergies, Change or loss of local wildlife (impacts to hunting, fishing, enjoyment of the outdoors), I | Major impacts | Major impacts |
| Wildfire damage, Breathing/vision impacts due to poor air quality | Major impacts | Major impacts |
| pacted air quality, Wildfires | Major impacts | Major impacts |
| Flooding/Flood damage, Wildfire damage, Property damage due to wind/storm impacts (wind, hail, erosion, water), Crop/vegetation/tree loss due to drought, More severe and/or longer impacts of allergies, Change or loss of local wildlife (impacts to hunting, fishing, enjoyment of the outdoors), Increased energy costs (c | Moderate impacts | Moderate impacts |
| Wildfire damage, Property damage due to wind/storm impacts (wind, hail, erosion, water), More severe and/or longer impacts of allergies, Increased energy costs (cooling and/or heating costs) | Moderate impacts | Major impacts |
| Property damage due to wind/storm impacts (wind, hail, erosion, water) | Major impacts | Major impacts |
| Wildfire damage, Property damage due to wind/storm impacts (wind, hail, erosion, water), Crop/vegetation/tree loss due to drought, More severe and/or longer impacts of allergies, Change or loss of local wildlife (impacts to hunting, fishing, enjoyment of the outdoors) | Moderate impacts | Major impacts |
| Wildfire damage, Property damage due to wind/storm impacts (wind, hail, erosion, water), Crop/vegetation/tree loss due to drought, Increased respiratory illnesses: duration and/or severity (asthma), More severe and/or longer impacts of allergies, Illness from mosquitos/ticks, Change or loss of local wildlife (impacts to | Major impacts | Major impacts |
| More severe and/or longer impacts of allergies, Breathing/vision impacts due to poor air quality, Increased energy costs (cooling and/or heating costs), Increased insurance costs | Major impacts | Moderate impacts |
| Flooding/Flood damage, Wildfire damage, Property damage due to wind/storm impacts (wind, hail, erosion, water), Crop/vegetation/tree loss due to drought, Increased respiratory illnesses: duration and/or severity (asthma), Breathing/vision impacts due to poor air quality, Illness from mosquitos/ticks, Change or loss o | Major impacts | Major impacts |

| How concerned are you with the effects of climate change regarding public health and welfare? | How concerned are you with the effects of climate change regarding public services and goods (e.g., roads, bridges, water, sewer, power, and internet)? | How concerned are you with the effects of climate change regarding local ecosystems (e.g., plant and animal life)? | Increase the number of people using public transit |
|---|---|---|---|
| Very concerned | Moderately concerned | | Low priority |
| Very concerned | Very concerned | Very concerned | Moderate priority |
| Very concerned | Very concerned | Moderately concerned | Moderate priority |
| Very concerned | Very concerned | Very concerned | Moderate priority |
| Very concerned | Moderately concerned | Very concerned | High priority |
| Moderately concerned | Moderately concerned | Very concerned | Moderate priority |
| Very concerned | Moderately concerned | Moderately concerned | Moderate priority |
| Very concerned | Very concerned | Very concerned | Moderate priority |
| Not concerned | Not concerned | Not concerned | Low priority |
| Moderately concerned | Slightly concerned | Moderately concerned | Moderate priority |
| Very concerned | Very concerned | Very concerned | Moderate priority |
| Very concerned | Very concerned | Very concerned | Moderate priority |
| Moderately concerned | Moderately concerned | Moderately concerned | Moderate priority |
| Very concerned | Very concerned | Very concerned | Moderate priority |
| Very concerned | Very concerned | Very concerned | High priority |
| Very concerned | Very concerned | Very concerned | Moderate priority |
| Very concerned | Very concerned | Very concerned | High priority |
| Very concerned | Very concerned | Moderately concerned | Moderate priority |
| Very concerned | Very concerned | Very concerned | Top priority |
| Very concerned | Very concerned | Very concerned | High priority |
| Very concerned | Very concerned | Very concerned | High priority |
| Very concerned | Moderately concerned | Moderately concerned | High priority |
| Very concerned | Very concerned | | Top priority |

| Expand public transit options | Encourage the use of shared mobility options (bike share, carpooling, ride share) | Expand the number of electric vehicle (EV) charging stations (public and private options) | Replace gas-powered vehicles with electric vehicles in the Tribal fleet | Develop more access to and encourage alternative energy systems (solar, wind, etc.) | Adopt energy efficiency standards in buildings |
|---|---|---|---|---|---|
| Moderate priority | Low priority | High priority | Moderate priority | High priority | High priority |
| Moderate priority | Moderate priority | Moderate priority | Moderate priority | High priority | High priority |
| Moderate priority | Moderate priority | High priority | Top priority | Top priority | Top priority |
| Moderate priority | Moderate priority | Moderate priority | Moderate priority | Moderate priority | Moderate priority |
| Top priority | Moderate priority | Low priority | Moderate priority | High priority | Top priority |
| Low priority | Moderate priority | Low priority | Not a priority | Moderate priority | Top priority |
| Moderate priority | Moderate priority | High priority | Top priority | High priority | Top priority |
| High priority | Moderate priority | Moderate priority | Moderate priority | High priority | High priority |
| Not a priority | Not a priority | Low priority | Not a priority | High priority | Moderate priority |
| Moderate priority | Moderate priority | Low priority | Moderate priority | Moderate priority | Moderate priority |
| Moderate priority | Low priority | Low priority | Moderate priority | High priority | High priority |
| High priority | High priority | Moderate priority | Not a priority | Moderate priority | High priority |
| Moderate priority | Low priority | Moderate priority | Low priority | High priority | Moderate priority |
| High priority | Moderate priority | Moderate priority | Moderate priority | High priority | High priority |
| High priority | High priority | Moderate priority | High priority | Top priority | High priority |
| Top priority | Top priority | Low priority | Not a priority | Top priority | Top priority |
| High priority | High priority | High priority | Low priority | Top priority | High priority |
| Moderate priority | High priority | Low priority | Low priority | Top priority | Top priority |
| Top priority | Top priority | Top priority | Moderate priority | Top priority | Top priority |
| Moderate priority | Top priority | High priority | Moderate priority | High priority | High priority |
| Moderate priority | Moderate priority | High priority | Moderate priority | Top priority | High priority |
| High priority | High priority | Moderate priority | Low priority | High priority | Top priority |
| Top priority | Top priority | Top priority | Top priority | Top priority | Top priority |

| Prioritize clean energy job creation | Prioritize renewable energy sources that convert forest floor materials (forest slash) into biofuels while also mitigating forest fire risk | Make recycling easier and more accessible | Reduce waste generated by the Tribal government and Tribal businesses | Implement composting programs for Tribal members and Tribal businesses | Reduce littering and illegal dumping |
|---|---|---|---|---|---|
| Moderate priority | High priority | High priority | Moderate priority | High priority | High priority |
| High priority | Top priority | Moderate priority | High priority | Moderate priority | High priority |
| Top priority | Top priority | High priority | High priority | Moderate priority | Top priority |
| Moderate priority | High priority | High priority | Moderate priority | Moderate priority | High priority |
| High priority | Top priority | Top priority | Top priority | Top priority | Top priority |
| Moderate priority | Top priority | High priority | Top priority | Top priority | Top priority |
| High priority | Moderate priority | Top priority | High priority | High priority | Top priority |
| Moderate priority | Moderate priority | High priority | High priority | High priority | Top priority |
| Not a priority | Not a priority | Moderate priority | Moderate priority | Low priority | High priority |
| Moderate priority | Moderate priority | Moderate priority | Moderate priority | Moderate priority | Moderate priority |
| High priority | Top priority | Moderate priority | Moderate priority | Low priority | Moderate priority |
| High priority | High priority | Moderate priority | High priority | High priority | Top priority |
| Moderate priority | Moderate priority | Moderate priority | Moderate priority | Moderate priority | Moderate priority |
| High priority | Top priority | Moderate priority | Moderate priority | Moderate priority | High priority |
| High priority | High priority | Moderate priority | High priority | High priority | High priority |
| Top priority | Top priority | Top priority | Moderate priority | Moderate priority | Top priority |
| High priority | Top priority | High priority | High priority | Top priority | Top priority |
| Top priority | Moderate priority | Top priority | Top priority | Top priority | Top priority |
| Top priority | Top priority | Top priority | Top priority | Top priority | Top priority |
| High priority | High priority | High priority | High priority | High priority | High priority |
| Top priority | Top priority | High priority | High priority | Moderate priority | Top priority |
| High priority | Low priority | Top priority | Top priority | Top priority | Top priority |
| Top priority | Top priority | Top priority | Top priority | Top priority | Top priority |

| Implement programs to target reductions in commercial waste | Inclusion of climate risk and environmental impact review in Tribal planning and decision making | Plant more trees | Develop conservation/preservation programs for lakes, waterways, and other ecologically sensitive areas | Develop programs designed to protect area pollinator species |
|---|---|---|---|---|
| Moderate priority | High priority | High priority | Moderate priority | Moderate priority |
| High priority | Top priority | Moderate priority | High priority | Moderate priority |
| High priority | High priority | Moderate priority | High priority | Moderate priority |
| Moderate priority | High priority | Top priority | High priority | High priority |
| High priority | High priority | Moderate priority | High priority | Low priority |
| High priority | High priority | Top priority | Top priority | Top priority |
| High priority | Top priority | Top priority | Moderate priority | Top priority |
| High priority | High priority | Moderate priority | High priority | Moderate priority |
| Low priority | Low priority | Low priority | Low priority | Low priority |
| Moderate priority | Moderate priority | Low priority | High priority | Moderate priority |
| Moderate priority | Top priority | Moderate priority | Moderate priority | Moderate priority |
| Top priority | High priority | Moderate priority | High priority | High priority |
| Moderate priority | Moderate priority | High priority | Moderate priority | Moderate priority |
| High priority | Moderate priority | Low priority | High priority | Low priority |
| High priority | High priority | High priority | High priority | High priority |
| Low priority | Moderate priority | Top priority | High priority | High priority |
| Top priority | Top priority | Top priority | Top priority | Top priority |
| Top priority | High priority | Moderate priority | High priority | High priority |
| Top priority | Top priority | Top priority | Top priority | Top priority |
| High priority | High priority | High priority | High priority | High priority |
| Moderate priority | High priority | Top priority | Top priority | High priority |
| Top priority | Top priority | Top priority | Top priority | Top priority |
| Top priority | Top priority | Top priority | Top priority | Top priority |

| Develop programs to reduce forest slash to mitigate the risk of wild fire | Provide cooling and heating centers during extreme temperature events | Create programs to address airborne pollutants and emerging air quality issues | Maintaining access to clean water and improving water quality | Ensure access to adequate food sources for all |
|---|---|---|---|---|
| High priority | Top priority | High priority | High priority | High priority |
| Top priority | High priority | Moderate priority | High priority | High priority |
| Top priority | Moderate priority | Moderate priority | High priority | High priority |
| High priority | Moderate priority | High priority | High priority | Top priority |
| Moderate priority | Moderate priority | Low priority | High priority | High priority |
| High priority | Moderate priority | Moderate priority | Top priority | High priority |
| High priority | High priority | Top priority | High priority | Top priority |
| Moderate priority | High priority | Moderate priority | Top priority | Top priority |
| Moderate priority | Moderate priority | Low priority | High priority | High priority |
| Top priority | Moderate priority | Moderate priority | High priority | High priority |
| Top priority | Not a priority | Low priority | Moderate priority | Moderate priority |
| Top priority | High priority | High priority | High priority | Top priority |
| Moderate priority | High priority | High priority | Moderate priority | Moderate priority |
| Top priority | High priority | Top priority | High priority | Top priority |
| Top priority | High priority | High priority | High priority | High priority |
| High priority | Top priority | Moderate priority | Moderate priority | Top priority |
| Top priority | Top priority | High priority | Top priority | Top priority |
| High priority | High priority | Moderate priority | Top priority | Top priority |
| Top priority | High priority | Top priority | Top priority | Top priority |
| High priority | Top priority | Top priority | Top priority | Top priority |
| Top priority | Top priority | Top priority | Top priority | Top priority |
| Top priority | Top priority | Top priority | Top priority | Top priority |
| Top priority | Top priority | Top priority | Top priority | Top priority |

| Examine the impact of extreme weather events on disaster response, access to critical services, transportation, housing, and recovery services | Implement programs to teach Climate and Resilience Health Awareness | Ideas, questions, comments or concerns (please detail below) |
|---|---|---|
| High priority | High priority | Provide $ support to install solar for homeowners |
| High priority | High priority | |
| High priority | High priority | Solar projects to help offset dependency on rising public utility costs would be great. |
| High priority | High priority | |
| Moderate priority | High priority | |
| Top priority | High priority | |
| Top priority | High priority | |
| Top priority | High priority | |
| Low priority | Low priority | |
| Moderate priority | Low priority | |
| Moderate priority | Low priority | |
| High priority | Moderate priority | |
| Moderate priority | Moderate priority | |
| Moderate priority | Moderate priority | |
| High priority | Top priority | |
| Top priority | Top priority | |
| Top priority | Top priority | |
| Top priority | Top priority | |
| Top priority | Top priority | |
| Top priority | Top priority | |
| Top priority | Top priority | |
| Top priority | Top priority | |
| Top priority | Top priority | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Timestamp | | 1 | 2 | 3 | 4 | 5 | |
| 10 | How concerned are you with the effects of climate change regarding local ecosystems (e.g., plant and animal life)? | 75 | 1 | | 5 | 10 | 7 | 91 |
| 9 | How concerned are you with the effects of climate change regarding public services and goods (e.g., roads, bridges, water, sewer, power, and internet)? | 81 | | 2 | | 5 | 16 | 104 |
| 6 | How would you rate the impacts of climate change on Tribal community health and welfare? | 82 | 1 | 1 | 5 | 16 | | 82 |
| 7 | How would you rate the impacts of climate change on public services and goods (e.g., roads, bridges, water, sewer, power, and internet)? | 82 | 1 | 1 | 5 | 16 | | 82 |
| 8 | How concerned are you with the effects of climate change regarding public health and welfare? | 86 | 1 | | 3 | 19 | | 86 |
| 2 | How much do you agree or disagree with the following statement: "I am informed about climate change. | 91 | 1 | 1 | 6 | 15 | | 81 |
| 3 | Is it important for the Tribe to prepare for the impacts of climate change? | 104 | 1 | | 6 | 14 | | 75 |
| | Transportation - How Would You Prioritize | 74 | | | | | | 0 |
| 15 | Replace gas-powered vehicles with electric vehicles in the Tribal fleet | 64 | | 2 | 13 | 6 | 2 | 77 |
| 14 | Expand the number of electric vehicle (EV) charging stations (public and private options) | 72 | 1 | 1 | 11 | 6 | 4 | 80 |
| 11 | Increase the number of people using public transit | 77 | 1 | 3 | 10 | 5 | 4 | 77 |
| 13 | Encourage the use of shared mobility options (bike share, carpooling, ride share) | 77 | | 7 | 8 | 6 | 2 | 72 |
| 12 | Expand public transit options | 80 | 4 | 4 | 11 | 1 | 3 | 64 |
| | Buildings and Energy - How Would You Prioritize | 94 | | | | | | 0 |
| 18 | Prioritize clean energy job creation | 89 | | | 4 | 11 | 8 | 96 |
| 19 | Prioritize renewable energy sources that convert forest floor materials (forest slash) into biofuels while also mitigating forest fire risk | 93 | | | 4 | 10 | 9 | 97 |
| 16 | Develop more access to and encourage alternative energy systems (solar, wind, etc.) | 96 | 1 | | 6 | 10 | 6 | 89 |
| 17 | Adopt energy efficiency standards in buildings | 97 | 1 | 1 | 5 | 5 | 11 | 93 |
| | Waste Management - How Would You Prioritize | 92 | | | | | | 0 |
| 22 | Implement composting programs for Tribal members and Tribal businesses | 87 | | | 8 | 8 | 7 | 91 |
| 24 | Implement programs to target reductions in commercial waste | 88 | | | 8 | 9 | 6 | 90 |
| 21 | Reduce waste generated by the Tribal government and Tribal businesses | 90 | | 2 | 8 | 6 | 7 | 87 |
| 20 | Make recycling easier and more accessible | 91 | | | 3 | 7 | 13 | 102 |
| 23 | Reduce littering and illegal dumping | 102 | | 2 | 6 | 9 | 6 | 88 |
| | Ecosystem Resiliency and Adpatation | 92 | | | | | | 0 |
| 28 | Develop programs designed to protect area pollinator species | 85 | | 1 | 4 | 11 | 7 | 93 |
| 26 | Plant more trees | 88 | | 3 | 7 | 4 | 9 | 88 |
| 27 | Develop conservation/preservation programs for lakes, waterways, and other ecologically sensitive areas | 92 | | 1 | 4 | 12 | 6 | 92 |
| 25 | Inclusion of climate risk and environmental impact review in Tribal planning and decision making | 93 | | 3 | 7 | 7 | 6 | 85 |
| 29 | Develop programs to reduce forest slash to mitigate the risk of wild fire | 100 | | | 4 | 7 | 12 | 100 |
| | Public Health - How Would You Prioritize | 94 | | | | | | 0 |
| 31 | Create programs to address airborne pollutants and emerging air quality issues | 86 | 1 | | 6 | 9 | 7 | 90 |
| 30 | Provide cooling and heating centers during extreme temperature events | 90 | | 3 | 7 | 6 | 7 | 86 |
| 35 | Implement programs to teach Climate and Resilience Health Awareness | 92 | | | 3 | 11 | 9 | 98 |
| 34 | Examine the impact of extreme weather events on disaster response, access to critical services, transportation, housing, and recovery services | 96 | | | 2 | 8 | 13 | 103 |
| 32 | Maintaining access to clean water and improving water quality | 98 | | 1 | 5 | 6 | 11 | 96 |
| 33 | Ensure access to adequate food sources for all | 103 | | 3 | 3 | 8 | 9 | 92 |
| | Ideas, questions, comments or concerns (please detail below) | | | | | | | |

| Question | Topic | Score |
|---|---|---|
| 33 | Ensure access to adequate food sources for all | 103 |
| 23 | Reduce littering and illegal dumping | 102 |
| 29 | Develop programs to reduce forest slash to mitigate the risk of wild fire | 100 |
| 32 | Maintaining access to clean water and improving water quality | 98 |
| 17 | Adopt energy efficiency standards in buildings | 97 |
| 16 | Develop more access to and encourage alternative energy systems (solar, wind, etc.) | 96 |
| 34 | Examine the impact of extreme weather events on disaster response, access to critical services, transportation, housing, and recovery services | 96 |
| 19 | Prioritize renewable energy sources that convert forest floor materials (forest slash) into biofuels while also mitigating forest fire risk | 93 |
| 25 | Inclusion of climate risk and environmental impact review in Tribal planning and decision making | 93 |
| 27 | Develop conservation/preservation programs for lakes, waterways, and other ecologically sensitive areas | 92 |
| 35 | Implement programs to teach Climate and Resilience Health Awareness | 92 |
| 20 | Make recycling easier and more accessible | 91 |
| 21 | Reduce waste generated by the Tribal government and Tribal businesses | 90 |
| 30 | Provide cooling and heating centers during extreme temperature events | 90 |
| 18 | Prioritize clean energy job creation | 89 |
| 24 | Implement programs to target reductions in commercial waste | 88 |
| 26 | Plant more trees | 88 |
| 22 | Implement composting programs for Tribal members and Tribal businesses | 87 |
| 31 | Create programs to address airborne pollutants and emerging air quality issues | 86 |
| 28 | Develop programs designed to protect area pollinator species | 85 |
| 12 | Expand public transit options | 80 |
| 11 | Increase the number of people using public transit | 77 |
| 13 | Encourage the use of shared mobility options (bike share, carpooling, ride share) | 77 |
| 14 | Expand the number of electric vehicle (EV) charging stations (public and private options) | 72 |
| 15 | Replace gas-powered vehicles with electric vehicles in the Tribal fleet | 64 |

# Appendix E

TGIT Input Data

Information from Invoices provided by HPUL.

| PG&E | | | Total | Average | Ferrellgas |
|---|---|---|---|---|---|
| Site | Month | kWh | kWh | kWh | propane (gal) |
| 10228 Elk Mountain Rd | 1/1/2022 | 542.540 | | | |
| 10228 Elk Mountain Rd | 2/1/2022 | 793.641 | | | |
| 10228 Elk Mountain Rd | 3/1/2022 | 422.478 | | | |
| 10228 Elk Mountain Rd | 4/1/2022 | 567.003 | | | |
| 10228 Elk Mountain Rd | 5/1/2022 | 358.157 | | | |
| 10228 Elk Mountain Rd | 6/1/2022 | 267.633 | | | |
| 10228 Elk Mountain Rd | 7/1/2022 | 316.869 | | | |
| 10228 Elk Mountain Rd | 8/1/2022 | 395.943 | | | |
| 10228 Elk Mountain Rd | 9/1/2022 | 719.479 | | | |
| 10228 Elk Mountain Rd | 10/1/2022 | 377.456 | | | |
| 10228 Elk Mountain Rd | 11/1/2022 | 985.742 | | | |
| 10228 Elk Mountain Rd | 12/1/2022 | 241.641 | | | |
| | | | 5988.582 | 499.049 | 370.9 |
| 10250 Dewell Rd Ext | 1/1/2022 | 209.881 | | | |
| 10250 Dewell Rd Ext | 2/1/2022 | 197.133 | | | |
| 10250 Dewell Rd Ext | 3/1/2022 | 221.708 | | | |
| 10250 Dewell Rd Ext | 4/1/2022 | 216.176 | | | |
| 10250 Dewell Rd Ext | 5/1/2022 | 213.494 | | | |
| 10250 Dewell Rd Ext | 6/1/2022 | 251.826 | | | |
| 10250 Dewell Rd Ext | 7/1/2022 | 247.764 | | | |
| 10250 Dewell Rd Ext | 8/1/2022 | 252.846 | | | |
| 10250 Dewell Rd Ext | 9/1/2022 | 264.767 | | | |
| 10250 Dewell Rd Ext | 10/1/2022 | 221.204 | | | |
| 10250 Dewell Rd Ext | 11/1/2022 | 217.762 | | | |
| 10250 Dewell Rd Ext | 12/1/2022 | 181.588 | | | |
| | | | 2696.149 | 224.679 | |
| 10250 Dewell Rd Ext Unit B | 1/1/2022 | 121.000 | | | |
| 10250 Dewell Rd Ext Unit B | 2/1/2022 | 148.000 | | | |
| 10250 Dewell Rd Ext Unit B | 3/1/2022 | 92.000 | | | |
| 10250 Dewell Rd Ext Unit B | 4/1/2022 | 89.000 | | | |
| 10250 Dewell Rd Ext Unit B | 5/1/2022 | 176.000 | | | |
| 10250 Dewell Rd Ext Unit B | 6/1/2022 | 175.000 | | | |
| 10250 Dewell Rd Ext Unit B | 7/1/2022 | 431.000 | | | |
| 10250 Dewell Rd Ext Unit B | 8/1/2022 | 749.000 | | | |
| 10250 Dewell Rd Ext Unit B | 9/1/2022 | 434.000 | | | |
| 10250 Dewell Rd Ext Unit B | 10/1/2022 | 142.000 | | | |
| 10250 Dewell Rd Ext Unit B | 11/1/2022 | 218.000 | | | |
| 10250 Dewell Rd Ext Unit B | 12/1/2022 | 391.000 | | | |
| | | | 3166.000 | 263.833 | |
| 375 E Highway 20 SPC5 | 1/1/2022 | 147.285 | | | |
| 375 E Highway 20 SPC5 | 2/1/2022 | 137.042 | | | |
| 375 E Highway 20 SPC5 | 3/1/2022 | 142.878 | | | |
| 375 E Highway 20 SPC5 | 4/1/2022 | 138.128 | | | |
| 375 E Highway 20 SPC5 | 5/1/2022 | 124.492 | | | |

| | | | | | |
|---|---|---|---|---|---|
| 375 E Highway 20 SPC5 | 6/1/2022 | 137.837 | | | |
| 375 E Highway 20 SPC5 | 7/1/2022 | 134.112 | | | |
| 375 E Highway 20 SPC5 | 8/1/2022 | 315.239 | | | |
| 375 E Highway 20 SPC5 | 9/1/2022 | 335.385 | | | |
| 375 E Highway 20 SPC5 | 10/1/2022 | 193.461 | | | |
| 375 E Highway 20 SPC5 | 11/1/2022 | 400.329 | | | |
| 375 E Highway 20 SPC5 | 12/1/2022 | 273.807 | Missing: average of Nov and Jan used. | | |
| | | | 2479.995 | 206.666 | |
| 375 E Highway 20 SPC6 | 1/1/2022 | 636.824 | | | |
| 375 E Highway 20 SPC6 | 2/1/2022 | 816.467 | | | |
| 375 E Highway 20 SPC6 | 3/1/2022 | 744.442 | | | |
| 375 E Highway 20 SPC6 | 4/1/2022 | 693.378 | | | |
| 375 E Highway 20 SPC6 | 5/1/2022 | 578.873 | | | |
| 375 E Highway 20 SPC6 | 6/1/2022 | 528.153 | | | |
| 375 E Highway 20 SPC6 | 7/1/2022 | 499.341 | | | |
| 375 E Highway 20 SPC6 | 8/1/2022 | 723.181 | | | |
| 375 E Highway 20 SPC6 | 9/1/2022 | 726.248 | | | |
| 375 E Highway 20 SPC6 | 10/1/2022 | 586.271 | | | |
| 375 E Highway 20 SPC6 | 11/1/2022 | 893.962 | | | |
| 375 E Highway 20 SPC6 | 12/1/2022 | 747.645 | | | |
| | | | 8174.785 | 681.232 | |
| 4685 W State Hwy 20 | 1/1/2022 | 60.431 | | | |
| 4685 W State Hwy 20 | 2/1/2022 | 56.681 | | | |
| 4685 W State Hwy 20 | 3/1/2022 | 53.442 | | | |
| 4685 W State Hwy 20 | 4/1/2022 | 46.294 | | | |
| 4685 W State Hwy 20 | 5/1/2022 | 39.033 | | | |
| 4685 W State Hwy 20 | 6/1/2022 | 43.827 | | | |
| 4685 W State Hwy 20 | 7/1/2022 | 24.633 | | | |
| 4685 W State Hwy 20 | 8/1/2022 | 19.393 | | | |
| 4685 W State Hwy 20 | 9/1/2022 | 23.983 | | | |
| 4685 W State Hwy 20 | 10/1/2022 | 21.045 | | | |
| 4685 W State Hwy 20 | 11/1/2022 | 26.533 | | | |
| 4685 W State Hwy 20 | 12/1/2022 | 29.260 | | | |
| | | | 444.555 | 37.046 | |
| 4827 W State Hwy 20 | 1/1/2022 | 230.799 | | | |
| 4827 W State Hwy 20 | 2/1/2022 | 254.909 | | | |
| 4827 W State Hwy 20 | 3/1/2022 | 371.468 | | | |
| 4827 W State Hwy 20 | 4/1/2022 | 219.937 | | | |
| 4827 W State Hwy 20 | 5/1/2022 | 205.170 | | | |
| 4827 W State Hwy 20 | 6/1/2022 | 222.253 | | | |
| 4827 W State Hwy 20 | 7/1/2022 | 137.206 | | | |
| 4827 W State Hwy 20 | 8/1/2022 | 161.898 | | | |
| 4827 W State Hwy 20 | 9/1/2022 | 167.692 | Missing: average of adjacent months used. | | |
| 4827 W State Hwy 20 | 10/1/2022 | 173.486 | | | |
| 4827 W State Hwy 20 | 11/1/2022 | 247.942 | | | |
| 4827 W State Hwy 20 | 12/1/2022 | 237.935 | | | |
| | | | 2630.695 | 219.225 | 1371 |

| | | | | | |
|---|---|---|---|---|---|
| 4827 W State Hwy 20 Apt 1 | 1/1/2022 | 16.000 | | | |
| 4827 W State Hwy 20 Apt 1 | 2/1/2022 | 97.365 | | | |
| 4827 W State Hwy 20 Apt 1 | 3/1/2022 | 25.179 | | | |
| 4827 W State Hwy 20 Apt 1 | 4/1/2022 | 24.834 | | | |
| 4827 W State Hwy 20 Apt 1 | 5/1/2022 | 29.021 | | | |
| 4827 W State Hwy 20 Apt 1 | 6/1/2022 | 46.181 | | | |
| 4827 W State Hwy 20 Apt 1 | 7/1/2022 | 62.581 | | | |
| 4827 W State Hwy 20 Apt 1 | 8/1/2022 | 75.192 | | | |
| 4827 W State Hwy 20 Apt 1 | 9/1/2022 | 49.929 | | | |
| 4827 W State Hwy 20 Apt 1 | 10/1/2022 | 34.473 | | | |
| 4827 W State Hwy 20 Apt 1 | 11/1/2022 | 55.787 | | | |
| 4827 W State Hwy 20 Apt 1 | 12/1/2022 | 340.708 | | | |
| | | | 857.250 | 71.438 | 224.3 |
| 4827 W State Hwy 20 Apt 11 | 1/1/2022 | 49.765 | | | |
| 4827 W State Hwy 20 Apt 11 | 2/1/2022 | 49.453 | | | |
| 4827 W State Hwy 20 Apt 11 | 3/1/2022 | 172.312 | | | |
| 4827 W State Hwy 20 Apt 11 | 4/1/2022 | 52.641 | | | |
| 4827 W State Hwy 20 Apt 11 | 5/1/2022 | 55.485 | | | |
| 4827 W State Hwy 20 Apt 11 | 6/1/2022 | 42.276 | | | |
| 4827 W State Hwy 20 Apt 11 | 7/1/2022 | 93.999 | | | |
| 4827 W State Hwy 20 Apt 11 | 8/1/2022 | 212.698 | | | |
| 4827 W State Hwy 20 Apt 11 | 9/1/2022 | 105.994 | | | |
| 4827 W State Hwy 20 Apt 11 | 10/1/2022 | 96.085 | | | |
| 4827 W State Hwy 20 Apt 11 | 11/1/2022 | 841.746 | | | |
| 4827 W State Hwy 20 Apt 11 | 12/1/2022 | 921.082 | | | |
| | | | 2693.536 | 224.461 | 42.1 |
| 4827 W State Hwy 20 Apt 4 | 1/1/2022 | 29.438 | | | |
| 4827 W State Hwy 20 Apt 4 | 2/1/2022 | 32.545 | | | |
| 4827 W State Hwy 20 Apt 4 | 3/1/2022 | 48.347 | | | |
| 4827 W State Hwy 20 Apt 4 | 4/1/2022 | 136.248 | | | |
| 4827 W State Hwy 20 Apt 4 | 5/1/2022 | 35.220 | | | |
| 4827 W State Hwy 20 Apt 4 | 6/1/2022 | 46.171 | | | |
| 4827 W State Hwy 20 Apt 4 | 7/1/2022 | 45.332 | | | |
| 4827 W State Hwy 20 Apt 4 | 8/1/2022 | 66.994 | | | |
| 4827 W State Hwy 20 Apt 4 | 9/1/2022 | 0.000 | | | |
| 4827 W State Hwy 20 Apt 4 | 10/1/2022 | 0.000 | | | |
| 4827 W State Hwy 20 Apt 4 | 11/1/2022 | 0.000 | | | |
| 4827 W State Hwy 20 Apt 4 | 12/1/2022 | 0.000 | | | |
| | | | 440.295 | 36.691 | 112.2 |
| 4827 W State Hwy 20 Apt 7 | 1/1/2022 | 10.930 | | | |
| 4827 W State Hwy 20 Apt 7 | 2/1/2022 | 14.685 | | | |
| 4827 W State Hwy 20 Apt 7 | 3/1/2022 | 20.127 | | | |
| 4827 W State Hwy 20 Apt 7 | 4/1/2022 | 28.421 | | | |
| 4827 W State Hwy 20 Apt 7 | 5/1/2022 | 62.664 | | | |
| 4827 W State Hwy 20 Apt 7 | 6/1/2022 | 78.381 | | | |
| 4827 W State Hwy 20 Apt 7 | 7/1/2022 | 32.554 | | | |
| 4827 W State Hwy 20 Apt 7 | 8/1/2022 | 18.344 | | | |

| | | | | | |
|---|---|---|---|---|---|
| 4827 W State Hwy 20 Apt 7 | 9/1/2022 | 0.000 | | | |
| 4827 W State Hwy 20 Apt 7 | 10/1/2022 | 0.000 | | | |
| 4827 W State Hwy 20 Apt 7 | 11/1/2022 | 35.303 | | | |
| 4827 W State Hwy 20 Apt 7 | 12/1/2022 | 312.057 | | | |
| | | | 613.466 | 51.122 | 75.7 |
| 4827 W State Hwy 20 Apt 9 | 1/1/2022 | 27.000 | | | |
| 4827 W State Hwy 20 Apt 9 | 2/1/2022 | 29.000 | | | |
| 4827 W State Hwy 20 Apt 9 | 3/1/2022 | 30.000 | | | |
| 4827 W State Hwy 20 Apt 9 | 4/1/2022 | 94.000 | | | |
| 4827 W State Hwy 20 Apt 9 | 5/1/2022 | 40.000 | | | |
| 4827 W State Hwy 20 Apt 9 | 6/1/2022 | 45.000 | | | |
| 4827 W State Hwy 20 Apt 9 | 7/1/2022 | 226.000 | | | |
| 4827 W State Hwy 20 Apt 9 | 8/1/2022 | 186.000 | | | |
| 4827 W State Hwy 20 Apt 9 | 9/1/2022 | 226.000 | | | |
| 4827 W State Hwy 20 Apt 9 | 10/1/2022 | 141.000 | | | |
| 4827 W State Hwy 20 Apt 9 | 11/1/2022 | 528.000 | | | |
| 4827 W State Hwy 20 Apt 9 | 12/1/2022 | 995.000 | | | |
| | | | 2567.000 | 213.917 | 22.4 |
| 650 E State Hwy 20 | 1/1/2022 | 456.000 | | | |
| 650 E State Hwy 20 | 2/1/2022 | 428.000 | | | |
| 650 E State Hwy 20 | 3/1/2022 | 409.000 | | | |
| 650 E State Hwy 20 | 4/1/2022 | 401.000 | | | |
| 650 E State Hwy 20 | 5/1/2022 | 384.000 | | | |
| 650 E State Hwy 20 | 6/1/2022 | 631.000 | | | |
| 650 E State Hwy 20 | 7/1/2022 | 706.000 | | | |
| 650 E State Hwy 20 | 8/1/2022 | 908.000 | | | |
| 650 E State Hwy 20 | 9/1/2022 | 606.000 | | | |
| 650 E State Hwy 20 | 10/1/2022 | 395.000 | | | |
| 650 E State Hwy 20 | 11/1/2022 | 734.000 | | | |
| 650 E State Hwy 20 | 12/1/2022 | 623.000 | | | |
| | | | 6681.000 | 556.750 | 212.8 |
| 815 Old Lucerne Rd | 1/1/2022 | 37.614 | | | |
| 815 Old Lucerne Rd | 2/1/2022 | 39.115 | | | |
| 815 Old Lucerne Rd | 3/1/2022 | 44.962 | | | |
| 815 Old Lucerne Rd | 4/1/2022 | 45.662 | | | |
| 815 Old Lucerne Rd | 5/1/2022 | 95.504 | | | |
| 815 Old Lucerne Rd | 6/1/2022 | 674.867 | | | |
| 815 Old Lucerne Rd | 7/1/2022 | 640.281 | | | |
| 815 Old Lucerne Rd | 8/1/2022 | 0.000 | | | |
| 815 Old Lucerne Rd | 9/1/2022 | 0.000 | | | |
| 815 Old Lucerne Rd | 10/1/2022 | 0.000 | | | |
| 815 Old Lucerne Rd | 11/1/2022 | 0.000 | | | |
| 815 Old Lucerne Rd | 12/1/2022 | 0.000 | | | |
| | | | 1578.005 | 131.500 | 124.8 |
| 9425 Main St (Carriage House) | 1/1/2022 | 43.388 | | | |
| 9425 Main St (Carriage House) | 2/1/2022 | 52.576 | | | |
| 9425 Main St (Carriage House) | 3/1/2022 | 53.672 | | | |

| | | | | | |
|---|---|---|---|---|---|
| 9425 Main St (Carriage House) | 4/1/2022 | 168.581 | | | |
| 9425 Main St (Carriage House) | 5/1/2022 | 56.971 | | | |
| 9425 Main St (Carriage House) | 6/1/2022 | 278.623 | | | |
| 9425 Main St (Carriage House) | 7/1/2022 | 299.001 | | | |
| 9425 Main St (Carriage House) | 8/1/2022 | 425.091 | | | |
| 9425 Main St (Carriage House) | 9/1/2022 | 330.312 | | | |
| 9425 Main St (Carriage House) | 10/1/2022 | 204.638 | | | |
| 9425 Main St (Carriage House) | 11/1/2022 | 685.914 | | | |
| 9425 Main St (Carriage House) | 12/1/2022 | 853.357 | | | |
| | | | 3452.124 | 287.677 | 33.4 |
| 9425 Main St (Main House) | 1/1/2022 | 303.124 | | | |
| 9425 Main St (Main House) | 2/1/2022 | 596.076 | | | |
| 9425 Main St (Main House) | 3/1/2022 | 383.907 | | | |
| 9425 Main St (Main House) | 4/1/2022 | 465.778 | | | |
| 9425 Main St (Main House) | 5/1/2022 | 442.548 | | | |
| 9425 Main St (Main House) | 6/1/2022 | 1232.080 | | | |
| 9425 Main St (Main House) | 7/1/2022 | 2450.840 | | | |
| 9425 Main St (Main House) | 8/1/2022 | 3009.725 | | | |
| 9425 Main St (Main House) | 9/1/2022 | 2498.059 | | | |
| 9425 Main St (Main House) | 10/1/2022 | 1362.348 | | | |
| 9425 Main St (Main House) | 11/1/2022 | 1557.283 | | | |
| 9425 Main St (Main House) | 12/1/2022 | 1418.333 | | | |
| | | | 15720.101 | 1310.008 | 749.2 |
| 9460 Main St | 1/1/2022 | 472.810 | | | |
| 9460 Main St | 2/1/2022 | 408.995 | | | |
| 9460 Main St | 3/1/2022 | 416.449 | | | |
| 9460 Main St | 4/1/2022 | 426.554 | | | |
| 9460 Main St | 5/1/2022 | 621.538 | | | |
| 9460 Main St | 6/1/2022 | 725.420 | | | |
| 9460 Main St | 7/1/2022 | 1361.617 | | | |
| 9460 Main St | 8/1/2022 | 1718.379 | | | |
| 9460 Main St | 9/1/2022 | 813.039 | | | |
| 9460 Main St | 10/1/2022 | 257.086 | | | |
| 9460 Main St | 11/1/2022 | 528.869 | | | |
| 9460 Main St | 12/1/2022 | 428.682 | | | |
| | | | 8179.438 | 681.620 | 1415.2 |
| 9470 Main St | 1/1/2022 | 4067.712 | | | |
| 9470 Main St | 2/1/2022 | 3298.344 | | | |
| 9470 Main St | 3/1/2022 | 2807.040 | | | |
| 9470 Main St | 4/1/2022 | 2605.152 | | | |
| 9470 Main St | 5/1/2022 | 2262.800 | | | |
| 9470 Main St | 6/1/2022 | 2258.032 | | | |
| 9470 Main St | 7/1/2022 | 2632.128 | | | |
| 9470 Main St | 8/1/2022 | 2896.616 | | | |
| 9470 Main St | 9/1/2022 | 2460.488 | | | |
| 9470 Main St | 10/1/2022 | 1763.760 | | | |
| 9470 Main St | 11/1/2022 | 3209.448 | | | |

| | | | | | |
|---|---|---|---|---|---|
| 9470 Main St | 12/1/2022 | 4240.424 | | | |
| CASINO | | | 34501.944 | 2875.162 | 2003.8 |
| Rancheria Rd | 1/1/2022 | 197.445 | Missing, Average of Feb and Dec used. | | |
| Rancheria Rd | 2/1/2022 | 206.803 | | | |
| Rancheria Rd | 3/1/2022 | 201.141 | | | |
| Rancheria Rd | 4/1/2022 | 233.565 | | | |
| Rancheria Rd | 5/1/2022 | 240.230 | | | |
| Rancheria Rd | 6/1/2022 | 345.590 | | | |
| Rancheria Rd | 7/1/2022 | 420.338 | | | |
| Rancheria Rd | 8/1/2022 | 457.516 | | | |
| Rancheria Rd | 9/1/2022 | 329.941 | | | |
| Rancheria Rd | 10/1/2022 | 218.694 | | | |
| Rancheria Rd | 11/1/2022 | 220.191 | | | |
| Rancheria Rd | 12/1/2022 | 188.087 | | | |
| | | | 3259.541 | 271.628 | |
| | | Elec | | Propane | |
| | Total | 106124 | kWh | 8572 | gal |
| | | 71623 | Residential | 6568 | Residential |
| | | 34502 | Casino | 2875 | Casino |

HPUL Fleet Data

| Owned Vehicles[3] | | Assumed[1] | Fuel[2] Used | |
|---|---|---|---|---|
| **Vehicle** | **Type** | **Mileage (annual)** | **(gallons)** | |
| 1. Ford E-350 12 passenger van | Light Truck | 6300 | 341 | |
| 2. Ford E-350 12 passenger van | Light Truck | 6300 | 341 | |
| 3. Honda CRV | Passenger Car | 6300 | 261 | |
| 4. Ford F-250 truck | Light Truck | 6300 | 341 | |
| 5. Dodge Caravan | Light Truck | 6300 | 341 | |
| | | | | |
| Leased Vehicles | | | | |
| 6. Chevrolet Traverse | Light Truck | 6300 | 341 | |
| 7. Chevrolet Traverse | Light Truck | 6300 | 341 | |
| 8. Chevrolet Traverse | Light Truck | 6300 | 341 | |
| 9. Chevrolet Suburban | Light Truck | 6300 | 341 | |
| 10. Chevrolet Suburban | Light Truck | 6300 | 341 | |
| 11. Chrysler Voyager | Light Truck | 6300 | 341 | |
| 12. Chrysler Voyager | Light Truck | 6300 | 341 | |
| 13. Ram 1500 truck | Light Truck | 6300 | 341 | |
| 14. Ram 1500 truck | Light Truck | 6300 | 341 | |
| | | 88200 | 4688 | Total |
| | | 81900 | 4427 | Light Trucks |
| | | 6300 | 261 | Passenger Car |

From EPA TGIT :

| | Average MPG | |
|---|---|---|
| **Vehicle Type** | **Gasoline & Other Fuels** | **Diesel & Biodiesel** |
| Passenger Car | 24.1 | 32.4 |
| Light Truck | 18.5 | 22.1 |
| Heavy-Duty Vehicle | 10.13 | 12.96 |
| Motorcycle | 50 | N/A |

1) Assuming 12.6 miles average commute each way. 50 weeks per year and 5 days per week. Mileage based on U.S. DOT, Federal Highway Administration, 2010 Status of the Nation's Highways, Bridges, and Transit: Conditons & Performance (https://www.fhwa.dot.gov/policy/2010cpr/execsum.cfm ).

2) Assume all gasoline fueled

3) Provided by Anthony Arroyo, Sr, HPUL

HPUL Waste Disposal Data

Lake Co. Waste Solutions invoices
Trash is tons, actual, weekly haul.
Recycling is container volume, and number of pickups. Not used in GHG inventory since not accurate.

| | | | Recycling | Recycling | | |
|---|---|---|---|---|---|---|
| | Trash | Recycling | times | cu yards | Recycling | |
| Date | Tons | cu yd | per week | per week | Total | |
| 11/1/2022 | 1.85 | | | | | |
| | 1.81 | | | | | |
| | 1.5 | | | | | |
| | 1.66 | | | | | |
| | | 3 | 2 | 6 | | |
| | | 6 | 2 | 12 | 18 | cu yards recycling per week, max |
| 10/3/2022 | 1.86 | | | | | |
| | 2.58 | | | | | |
| | 1.46 | | | | | |
| | 1.99 | | | | | |
| | | 3 | 2 | | | |
| | | 6 | 2 | | | |
| 9/1/2022 | 1.95 | | | | | |
| | 2.41 | | | | | |
| | 1.63 | | | | | |
| | 0.84 | | | | | |
| | 1.4 | | | | | |
| | | 3 | 2 | | | |
| | | 6 | 2 | | | |
| 8/1/2022 | 1.8 | | | | | |
| | 1.99 | | | | | |
| | 1.85 | | | | | |
| | 2.42 | | | | | |
| | | 3 | 2 | | | |
| | | 6 | 2 | | | |
| 7/1/2022 | 2.12 | | | | | |
| | 1.72 | | | | | |
| | 1.7 | | | | | |
| | 1.61 | | | | | |
| | | 3 | 2 | | | |
| | | 6 | 2 | | | |
| 6/1/2022 | 2.18 | | | | | |
| | 1.94 | | | | | |
| | 2.12 | | | | | |
| | | 3 | 2 | | | |
| | | 6 | 2 | | | |
| 5/1/2022 | 1.77 | | | | | |
| | 1.92 | | | | | |
| | 1.72 | | | | | |
| | 2.25 | | | | | |
| | | 3 | 2 | | | |
| | | 6 | 2 | | | |
| | | | | | Total | |
| Average | 1.858929 | per haul | | | 864 | cu yards recyclng per year |
| | 52 | hauls per year | | | 139 | lb/cu yd (EPA source) |
| | 96.66429 | tons per year | | | 120096 | lb/yr, max |
| | Entered in WARMv16 model. | | | | 60.048 | tpy, max |

No other data provided, extrapolate for 12 months.

HPUL lands: GIS assignment of category

| Row Labels | Sum of Acres | % | | |
|---|---|---|---|---|
| Cultivated Crops | 14.716167 | 2.8% | | |
| Deciduous Forest | 4.45262 | 0.9% | | |
| Developed, High Intensity | 1.90059 | 0.4% | | |
| Developed, Low Intensity | 7.508377 | 1.5% | | |
| Developed, Medium Intensity | 7.568278 | 1.5% | | |
| Developed, Open Space | 40.345405 | 7.8% | | |
| Emergent Herbaceous Wetlands | 29.55066 | 5.7% | | |
| Evergreen Forest | 6.881322 | 1.3% | | |
| Hay/Pasture | 57.835678 | 11.2% | | |
| Herbaceous | 236.686841 | 45.7% | | |
| Mixed Forest | 9.071807 | 1.8% | | |
| Shrub/Scrub | 73.39876 | 14.2% | | |
| Woody Wetlands | 27.571609 | 5.3% | | |
| (blank) | | | | |
| **Grand Total** | **517.488114** | | 247 | acres/sq km |
| | Acres | km2 | | |
| Urban | 16.977245 | 0.068734 | | |
| Forested | 11.333942 | 0.045886 | | |
| Overlap | 1.6977245 | 0.006873 | assume 10% or less based on maps | |

Septic Tanks

Assume 28 tanks, 4 persons per tank = 112 persons. For EPA Tool input.

| HPUL Properties w Septic | | 1/18/2024 |
|---|---|---|
| Item | Location | No of Tanks |
| 1 | Hill House | 1 |
| 2 | Blue Lakes | 7 |
| 3 | Dewell Rd Ext | 2 |
| 4 | Elk Mountain | 1 |
| 5 | 625 E Hwy 20 | 2 |
| 6 | AASr on Dewell | 1 |
| 7 | SO on Dewell | 2 |
| 8 | DJ on Rancheria | 1 |
| 9 | AS on Rancheria | 1 |
| 10 | AJ on Rancheria | 2 |
| 11 | RBSr on Rancheria | 1 |
| 12 | RBJr on Rancheria | 1 |
| 13 | RB on Rancheria | 1 |
| 14 | EB on Rancheria | 1 |
| 15 | LLF on Rancheria | 1 |
| 16 | WSSr on Rancheria | 1 |
| 17 | JMSr on Rancheria | 2 |
| | | |
| | **TOTAL** | **28** |

Data provided by: Rodney Williams, John T Williams Law

HPUL GHG Inventory
Co-pollutants for energy use
Assumptions:
One metric ton CO2 equals:

| | | | |
|---|---|---|---|
| Gasoline | 0.125 | MMBtu/gal | (40 CFR Part 98, Subpart C) |
| | 70.22 | kg CO2/MMBtu | (40 CFR Part 98, Subpart C) |
| | 8.7775 | kg CO2/gal | |
| | 1000 | kg/Mton | |
| | 113.927656 | gal/Mton CO2 | |
| Propane | 0.091 | MMBtu/gal | (40 CFR Part 98, Subpart C) |
| | 62.87 | kg CO2/MMBtu | (40 CFR Part 98, Subpart C) |
| | 5.72117 | kg CO2/gal | |
| | 1000 | kg/Mton | |
| | 174.789422 | gal/Mton CO2 | |
| Natural Gas | 1.03E-03 | MMBtu/scf | |
| | 53.06 | kg CO2/MMBtu | |
| | 5.44E-02 | kg CO2/scf | |
| | 1000 | kg/Mton | |
| | 0.01837 | MMscf/Mton CO2 | |

**Table 3. Amount Co-Pollutant Reduced by Reduction of one Metric ton GHG:**

**Gasoline Use**

| Criteria Pollutant | lb/MMBtu | TPY reduction |
|---|---|---|
| PM | 0.1 | 6.64E-04 |
| PM10 | 0.1 | 6.64E-04 |
| PM2.5 | 0.1 | 6.64E-04 |
| NOX | 1.63 | 1.08E-02 |
| CO | 0.99 | 6.57E-03 |
| SOX | 0.084 | 5.57E-04 |
| TOC Total | 3.03 | 2.01E-02 |
| **HAP/TAP** | | lb/yr Reduction |
| Acetaldehyde(H,T) | 0.000767 | 1.02E-02 |
| Formaldehyde(H,T) | 0.00118 | 1.57E-02 |
| Total HAP | | 2.58E-02 |

116485 Btu/gal

(using AP-42, Section 3.3)

**Propane Use**

| Criteria Pollutant | TPY reduction |
|---|---|
| PM (Total) | 4.26E-06 |
| PM (Filterable) | 1.65E-06 |
| PM (Condensable) | 2.61E-06 |
| PM2.5 (Total) | 3.56E-06 |
| PM2.5 (Filterable) | 8.69E-07 |
| SO2 | 1.30E-06 |
| NOX | 1.13E-03 |
| CO | 6.52E-04 |
| TOC | 8.69E-05 |

Btu/gal

(using AP-42 Section 1.5)

**Natural Gas Use**

| Criteria Pollutant | TPY Reduction |
|---|---|
| $NO_X$ | 2.94E-04 |
| CO | 7.71E-04 |
| PM* (Total) | 4.78E-06 |
| PM (Filterable) | 1.84E-06 |
| PM (Condensable) | 2.94E-06 |
| PM2.5** (Total) | 3.95E-06 |
| PM2.5 (Filterable) | 1.01E-06 |
| $SO_2$ | 5.51E-06 |
| TOC | 1.01E-04 |
| VOC | 5.05E-05 |
| **HAP/TAP** | **lb/yr Reduction** |
| Total HAP | 3.33E-02 |
| Largest HAP | 5.88E-02 |

(using AP-42 Section 1.4)