Preliminary Greenhouse Gas Emission Analysis for Clean Planet Energy ecoPlant Technology

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Commissioner of the study:
Pyroplast Energy Limited trading as Clean Planet Energy

Practitioner of the study: Stopford Projects Limited

Reviewed & Validated by:
Carbon Action Consulting Limited

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Introduction

The purpose of the calculations of Greenhouse Gas (GHG) emissions is for Clean Planet Energy (CPE) to communicate transparently to its stakeholders, partners, clients, and the general public, the potential climate impacts of its operations, and how Clean Planet Energy, by managing non-recyclable plastic waste, can help our oceans and air to be cleaner.

The objective of this review was to ensure that the data and methodology used initially by CPE to calculate the GHG emissions of its products are scientifically and technically valid, given the assumptions initially made and the data that is available to the public. To reduce the uncertainty and increase the robustness of the calculations, CPE commissioned Stopford, an international energy and environment consultancy, to conduct an independent detailed study using the core principles of ISO14064.

This executive summary encapsulates the emission category findings and key findings, based on GHG emissions quantification and reporting, according to ISO 14064 guidance, as a result of the work carried out by CPE and Stopford.

Executive Summary

Clean Plant Energy's (CPE) ecoPlants present a significant opportunity to enable the circular production of fuels and commodities from non-recyclable plastic waste. Using proprietary pyrolysis and oil-upgrading technology to produce liquid hydrocarbon products and pyrolysis gas from waste plastic, CPE has the potential to substantially reduce the GHG emissions associated with the production of Naphtha, Diesel and Fuel Oil, compared to that of fossil fuel-derived products.

Through the application of Well-to-Tank and Well-to-Wheel GHG emissions boundaries, representing production emissions and life-cycle emissions respectively, estimated GHG emissions were calculated for CPE's processes and products and compared to that of conventional fossil fuel-derived products and processes.

Emission Category Findings

Key findings from the described study include:

Extraction: As CPE's process feedstock is derived from waste plastics, extraction phase GHG emissions are calculated to be zero.

Production: The application of CPE's proprietary pyrolysis and oil-upgrading technology enables an estimated 47% reduction in production phase GHG emission, for all liquid hydrocarbon products, compared to that of a conventional fossil fuel process. This can be attributed to the fact that CPE's ecoPlants are designed to be self-powered, utilising a combination of pyrolysis gas and solar-PV technology to meet process heat and power demand.

Usage: Whilst no GHG emission savings were calculated forecast through the usage phase (combustion) of CPE's liquid hydrocarbon fuel products, compared to fossil fuel-derived equivalents, a significant reduction in NOx, CO and SOx emissions are anticipated from the use of CPE's fuels.

It must be noted that the emission factor for Naphtha has considered DEFRA (2020) on the basis of fuel combustion. However, the intended application of the Naphtha is as a chemical feedstock for the Petrochemical Industry (non-combustion), which is likely to result in an over-estimation of the current use phase fuel combustion Naphtha emission factor, providing a more conservative measurement of CPE's GHG savings than is likely to occur.

Well-to-Tank: As CPE's liquid hydrocarbon fuels are produced from non-recyclable waste plastics, displacing fossil fuel derived fuel production as well as avoiding plastics disposal via incineration, maximum GHG emissions savings of up to 330% (416 kgCO2e/barrel) are anticipated compared to conventional fossil fuel derived processes and products.

Well-to-Wheel: As CPE's liquid hydrocarbon fuels are produced from non-recyclable waste plastics, displacing fossil fuel derived fuel production as well as avoiding plastics disposal via incineration, maximum life cycle GHG emissions savings of up to 78% are anticipated compared to conventional fossil fuel derived processes and products.

As such, this study has served to identify that as well as providing a sustainable solution to the management of non-recycle plastics waste, CPE's proprietary eco-Plants plant technology enables the decarbonisation of transport fuels when compared to fossil-derived equivalents.

Key Findings

1. Clean Planet's liquid fuels provide at least a 78% reduction in CO2e emissions compared to traditional fossil fuels, considering 100% incineration avoidance.

2. Clean Planet's liquid fuels provide at least a 48% reduction in CO2e emissions compared to traditional fossil fuels, considering 50% incineration avoidance and 50% landfill avoidance.

3. For every barrel of Clean Planet's liquid fuel used in replacement of traditional fossil fuels, 416 kg of CO2e emissions are stopped from entering the atmosphere, considering 100% incineration avoidance.

4. For every barrel of Clean Planet's liquid fuel used in replacement of traditional fossil fuels, 257 kg of CO2e emissions are stopped from entering the atmosphere, considering 50% incineration and 50% landfill avoidance.

5. For every barrel of Clean Planet's liquid fuel used in replacement of traditional fossil fuels, 98 kg of CO2e emissions are stopped from entering the atmosphere, considering 100% landfill avoidance.

6. CPE's ecoPlants are designed to be self-powered, utilising the syngas produced to heat and power the production plant. In addition, solar PV technology is designed to be used to meet any excess power demand.

Key Assumptions

- "Well-to-Tank" represents the pyrolysis process and oil-upgrading process only, hence GHG savings attributable to avoidance of fossil fuel extraction have been discounted, whilst GHG emission savings from the avoidance of waste plastic disposal to landfill and incineration have been included.
- "Well-to-Wheel" considers a conventional fossil fuel (diesel) GHG emission boundary in which the GHG emissions associated with fuel use are included, as well as emission savings from the avoidance of waste plastic disposal to landfill and incineration.
- Carbon dioxide equivalent (CO_2e) data has been acquired across the "extraction", "production", "use" and "plastics disposal avoidance" emission categories.
- GHG emissions associated with the carbon residues have been excluded.
- To enable data to be normalised, all CO_2e data has been presented on a "per barrel" basis.
- This study assumes a blend of Naphtha, Diesel and Fuel Oil fractions within each barrel of liquid hydrocarbons produced from CPE's pyrolysis process.
- GHG emissions attributable to CPE's extraction phase equate to 0 $kgCO_2e$/barrel.

- The production phase GHG emissions in this study only account for the displacement associated with the production phase of fossil diesel via the normal processing route.
- 59 tonnes of CPE plastic waste results in 332 barrels of liquid products.
- Hydrogen is produced on-site by renewable sources.
- All the heat energy for the plant is provided self-sufficiently by combustion of the pyrolysis off-gas, distillation residue and 3% of the product oil.
- Composition of feedstock is assumed to be a wet mixed plastic-rich material that is unsuitable for reuse or recycling.
- It has been assumed that 70% of the waste would be sourced within a 100km radius of the plant, whilst the remaining 30% would travel 350km to the site.
- The current distance waste from Materials Recovery Facilities (MRFs) is transported to landfill is assumed to be 25km. This figure has also been used as the distance for solids disposal of any material arising from any new facility.
- Emissions associated with the consumption of each fuel product remains the same for CPE's fuel and conventional fuel.

Peer Review Summary

Our responsibility is to express an opinion on the forecast based on our assessment of the CPE Project document. We conducted our assessment in accordance with ISO 14064- 3:2019 with guidance for the validation of greenhouse gas statements, in so far as practicable. This International Standard requires that we comply with ethical requirements and perform the validation to obtain limited assurance that the forecast in the GHG statement is based on reasonable assumptions. The data examined during the assessment were projected in nature.

Based on our examination of the evidence, nothing comes to our attention which causes us to believe that these assumptions do not provide a reasonable basis for the CPE forecasts. Actual results are likely to be different from the forecast since anticipated events frequently do not occur as expected, and the variation may be material.

Based on the process and procedures conducted, there is no evidence that the CPE GHG statement: — is not materially correct and is not a fair representation of GHG data and information; — has been prepared in accordance with related International Standards on GHG quantification, monitoring and reporting.

A limited level of assurance has been provided. This requires that the validator agrees that the project design documents have been developed such that the CPE methods and estimates of potential GHG reductions are appropriate. It must also be validated that these GHG assertions contains no material discrepancies.

Further, in our opinion, the CPE forecast is properly prepared on the basis of the assumptions made and available data used. Please see the report entitled "VALIDATION REPORT OF C.P.E Project Number: 6598_CA_01" for further details.

Authorised Signatures

AGREED by both parties through their authorised signatories:

	For and behalf of **Stopford Projects Limited**		For and behalf of **Carbon Action Consultants Limited**
Name	Dr Ben Herbert (Technology & Innovation Director)	Name	Fergal Mee (GHG Director)
Signatures		Signature	
Date	11.12.2020	Date	14 – Dec – 20