भारतीय प्रौद्योगिकी संस्थान मुंबई
पवई, मुम्बई – 400 076 , भारत
Indian Institute of Technology Bombay
Powai, Mumbai - 400 076, India

दूरभाष/Phone : (+91-22) 2572 2545
फैक्स/Fax : (+91-22) 2572 3480
वेबसाइट/Website : www.iitb.ac.in

IIT Bombay

To
Mr. Yashodhan Ramteke
Meta Materials Circular Markets

31st Aug 2023

Sub: Our opinion and analysis of the carbon credits calculation

Dear Sir,

It was a pleasure associating with you and interacting closely to understand the calculation of carbon credits.

We are happy to be involved with the analysis and the successful validation of the MMCM methodology of carbon credits accounting that has been used in the MTC Group process: attached is our report.

We are available for any clarifications/queries. Below are our contact details.

With best regards

31st August 2023

Dr. Madhu N. Belur and Dr. Kumar Appaiah
Dept of Electrical Engineering, IIT Bombay
Ph: 9987 466 279 and 9757 02 4889
Email: akumar@ee.iitb.ac.in, belur@ee.iitb.ac.in

Technical opinion on “Procedure for Potential Saving of CO_2 Re-emission during Scrapping of End-Of-Life Vehicles”: MTC Business Private Limited

31st August, 2023

This report is about a technical/scientific opinion on the MTC-group-authored white-paper titled “CO_2 Emission Avoidance Methodology For Scrapping End-Of-Life Vehicles” [4]. For this report, “the client” refers to MTC Group, and this report’s authors belong to “IIT Bombay”.

Disclaimer

The contents of this report are purely technical/scientific and non-legal in nature and based on the information/facts disclosed by the client. The client shall be solely responsible for any use/utilisation of this report. All warranties or representations of any kind pertaining to the report or its contents are hereby expressly **excluded**. Further, the calculations are consistent with the parameters listed in UN CDM AMS-III.BA. document, Version 3, dated 9th September 2021: see Reference [1]. Upon the release of an updated version by UN CDM, as and when released, appropriate changes to the calculation procedure and parameters would be needed.

Introduction and Background

The MTC Group has been in the business of recycling over several decades, particularly in the field of metal scrap recycling and trading. Recently, the company has been working on a proposal for developing a marketplace for trading credits for recycling and scrapping end-of-life vehicles. It is quite likely that government policy and phasing out of old vehicles will result in several vehicles being scrapped, and an effective marketplace to trade credits for recycling would benefit manufacturers and customers alike.

As part of this endeavour, the MTC group has a working white paper titled “CO2 Emission Avoidance Methodology For Scrapping End-Of-Life Vehicles” [4]. The White Paper is closely based on United Nations guidelines on how credits for recycling are to be accounted for, and such accounting and maintenance of a credit-system is intended to encourage re-use of scrapped waste, and thus encourage more sustainable practices within customers in the vehicle industry.

This report is restricted to evaluating the calculation procedure of the calculation of credits for end-of-life vehicle scrapping and recycling and its concurrence with the United Nations Framework Convention on Climate Change under its Clean Development Mechanism documents AMS-III.BA. (Recovery and recycling of materials from E-waste) and AMS-III.AJ. (Recovery and recycling of materials from solid wastes). Please refer to UN CDM AMS-III.BA. document, Version 3, dated 9th September 2021 [1] and also [2] for further details.

Comments on the Proposed Procedure

The key idea behind the calculation procedure is to quantify the CO2 emission savings benefit obtained by recovering recycled materials, particularly plastics and metals, from end-of-life vehicles, while accounting for the energy and other costs associated with the recycling process. To this end, the cost benefits accrued by recovering plastics and metals is reduced by the amount of energy and costs involved in the recovery process. The procedure for this calculation as presented in the white paper is summarized briefly below. All emission and energy related quantities that we consider are yearly averages, unless otherwise specified.

- The emission reduction is obtained by evaluating the baseline CO2 emission reduction and reducing it by the project emission (emissions involved during the recycling process) and the leakage emissions. The baseline emissions account for the "savings" in CO_2 emission achieved due to the recycling process, while the project emissions quantify the equivalent CO_2 emissions incurred during the recycling process.
- Subsequently, the contents and recyclable material in end-of-life vehicles is enumerated. For the sample calculation, the research report titled "Development of scientific recycling of End of Life Automobiles in India and the role of Research and Development" (Ram, Adhikari, & Sugumar, INAE, 2015). We remark here that the precise contents would differ based on the actual composition of the specific end-of-life vehicle being considered.
- Each of the recyclable materials is categorised into metals or plastics, along with an estimate of their weight in the EOL vehicle.
- The baseline emission for metals is then evaluated by estimating the CO_2 emission reduction based on the weight of each metal component. The specific emission (tonnes of CO_2 emitted per megaton of each metal produced) is used as per the UN CDM AMS-III.BA. document, Version 3. We also remark that there is a baseline correction factor for "non-annex countries" specified in the same document that has been accounted for in the white paper. This is to quantify the differences in production processes across countries that cause a change in the specific emission within those countries for these materials.
- A similar approach is employed for the baseline correction for plastics. In this evaluation, the following aspects are accounted for:
    - An adjustment factor that accounts for whether the recycling facility performs only dismantling or if it additionally has smelting facilities.
    - A partition of the calculation based on the fraction of the plastic material produced within the country against the corresponding amount imported from other countries.
    - The material-wise specific CO_2 emission for each of the materials, based on in-country produced and imported. These account for the specific electricity and fuel consumptions for plastics produced in-country and outside.
- Once the baseline emissions have been calculated, the project emissions are calculated, the project emissions, i.e. the CO_2 emissions that occur as part of the recycling project are evaluated as follows:

    - The emissions are segregated into those that occur due to the sorting and processing of the waste within the recycling facility and those that occur due to processing in third party facilities (if applicable).
    - The project emissions are obtained by accounting for the electrical and fuel energy consumed during the recycling process
- Finally, the leakage emissions are accounted for. We remark here that the current version of the white paper indicates that no leakages have been identified. This is possible only if all leakages have been accounted for in the component-wise energy consumption in the other parameters discussed above.

Observations

The following are our observations on the white paper contents and the carbon credits calculation procedure:

- The calculation procedure outlined in the white paper is consistent with the UN AMS-III.BA. document. In fact, the calculation process is exactly equivalent to the equations (1) through (13) listed in AMS-III.BA.
- The correction factors used (non-annex countries, baseline corrections etc.) are chosen in accordance with the UN documents AMS-III.BA. and AMS-III-AJ.
- The assumptions on the vehicle metal and plastic content is based solely on “Development of scientific recycling of End of Life Automobiles in India and the role of Research and Development” ([3] Ram, Adhikari, & Sugumar, INAE, 2015). While this could be a suitable starting point, we remark that the precise contents of the end-of-life vehicles could vary, and thus, may result in more or less CO_2 savings due to the recycling process.
- We conducted an independent evaluation of the calculation procedure presented in the white paper, and compared our results with those presented to us by the client based on evaluations with various parameters. We found that the results presented by the client were consistent with the CO_2 savings calculations that we obtained from our independent evaluation.

Summary

We have performed an individual evaluation of the white paper titled “CO2 Emission Avoidance Methodology For Scrapping End-Of-Life Vehicles” [4] authored by MTC Business Private Limited. Based on our evaluation:

- The white paper presents a calculation of the CO2 savings that can be obtained by recycling end-of-life vehicles using standard recycling practices. This could go on towards a credit system for exchange of CO2 credits in a marketplace setting in future.
- The calculation procedure for CO2 savings and the assumptions made for these calculations are closely based on the United Nations Framework Convention on Climate Change under its Clean Development Mechanism documents AMS-III.BA. (Recovery and

recycling of materials from E-Waste) and AMS-III.AJ. (Recovery and recycling of materials from solid wastes). We have confirmed that the evaluation procedure adopted in the white paper conforms to the specifications outlined in these documents.

- We have performed an independent evaluation of the CO2 saving calculation procedure outlined in the white paper. The assumptions on the parameters are largely based on the aforementioned UN documents as well as publicly available data. Our evaluation revealed that calculations were consistent with the evaluation presented in the white paper.
- We remark that assumptions regarding vehicle compositions, leakage and changes in other parameters will cause variations in the CO2 savings. These need to be considered when using this procedure for different scenarios.

Important references:

[1] Clean Development Mechanism, U.N. Framework for Climate Change (UNFCC), 2021, "Small-scale Methodology: Recovery and Recycling Materials from E-waste", https://cdm.unfccc.int/UserManagement/FileStorage/V5YDLWT4JU1RZ8QSNFHIA93M7G20EK. Last accessed on 21st Aug 2023.

[2] Clean Development Mechanism, U.N. Framework for Climate Change (UNFCC), 2021, "AMS-III.BA.: Recovery and recycling of materials from E-waste - Version 3.0", https://cdm.unfccc.int/methodologies/DB/TO0E8JPL9361FDB1IPF0TUPS0WJXV3. Last accessed on 21st Aug 2023.

[3] Ram, N. M., Adhikari, B., & Sugmar, S., Development Of Scientific Recycling of End Of Life Automobiles in India and The Role of Research and Development. Indian National Academy of Engineering, 2015.

[4] Biswas, G. and others from MTC Group, CO2 Emission Avoidance Methodology For Scrapping End-Of-Life Vehicles, pdf-file: version dated 15th August 2023.

31st August 2023

Dr. Madhu N. Belur and Dr. Kumar Appaiah
Dept of Electrical Engineering, IIT Bombay
Ph: 9757 02 4889 and 9987 466 279
Email: akumar@ee.iitb.ac.in, belur@ee.iitb.ac.in