**RETASTE Conference Abstracts**
Vol. 1 RETASTE-W2E-102
Athens, Greece, 6-8 May, 2021


# Waste-To-Fuel: Life Cycle Assessment of Hydrothermal Liquefaction of Household Food Waste

Ioan-Robert Istrate, Enrique Medina-Martos, Jose-Luis Galvez-Martos and Javier Dufour

*Systems Analysis Unit, IMDEA Energy (Spain)*

## Abstract

The goal of this study is to evaluate the life cycle environmental impacts associated with the hydrothermal liquefaction (HTL) of households' food waste to produce diesel and gasoline. The functional unit was defined as *the treatment of 1,000 kg (wet basis) food waste provided by households (including impurities)*. The system boundary encompasses the following stages: (I) pre-treatment and sorting of the input waste, (II) HTL treatment, (III) bio-oil upgrading and refining to diesel and gasoline, (IV) landfilling of the solid fraction, and (V) incineration of the pre-treatment rejects. In order to evaluate the potential benefits of the Waste-to-Fuel solution, the HTL system was credited for the avoided environmental burdens due to the substitution of fossil diesel and gasoline. The main source of data to develop the life cycle inventory was the simulation of the process in Aspen Plus. The life cycle environmental impact assessment was performed with the ReCiPe hierarchical method. The results reveal a positive impact (i.e. produced burdens higher than avoided burdens) for all categories but fossil resources. This means that the credits assigned to the HTL due to the production of diesel and gasoline counterbalance the fossil resources consumed by the system. Direct emissions from HTL are the main contributor to the impact on terrestrial acidification (94%), particulate matter formation (85%), and photochemical ozone formation (41%). The incineration of the rejects has the highest contribution to the impact on climate change (53%), freshwater eutrophication (66%), and human toxicity (90%). We found that as high as 36% of the input waste is rejected due to the contamination of the food waste with non-biodegradable materials. The life cycle climate change impact of HTL was compared against anaerobic digestion (AD) with biomethane upgrading. If excluding the incineration of rejects (same for both systems), the results show that HTL (1.77 kg $CO_2$ eq/t food waste) offers climate benefits compared to AD (57.14 kg $CO_2$ eq/t food waste). The higher climate change impact of AD is mainly due to the leakage of methane, which does not occur when using HTL. Furthermore, the environmental credits due to the substitution of fossil diesel and gasoline are considerably larger than the credits due to the substitution of natural gas with biomethane.

**Keywords:** food waste, hydrothermal liquefaction, life cycle assessment, food waste management

**Acknowledgments:** This research has been supported by the Spanish Ministry of Science,

Innovation and Universities through the project REDEFINERY (RTI2018-097227-B-I00) and the Government of the Community of Madrid through the project BIO3 (S2018/EMT-4344)