

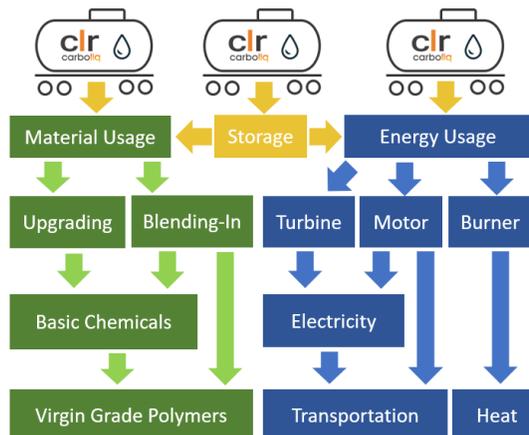
# Plastic Waste to Liquid Resource

## Introduction

The next years are set to be an age of transition for the energy and materials worlds, and these themes will become increasingly prevalent in business, society and politics. For the petrochemicals industry, the winning formula will come in finding the balance between financial and environmental sustainability. For waste industry, it is all about participation in value added coming from resource recovery and resource regeneration. When it comes to waste plastics, mechanical sorting is limited. Reprocessing plastics without a loss of function and value means changing the paradigms of plastic's recycling as we know them. The hydrocarbon resource has to be regenerated to be available for the production of high-quality goods or fuels.



CARBOLIQ GmbH has proven to transfer mixed plastic waste into a liquid resource applying a one stage conversion technology. Its pilot plant is of industrial scale, runs in 24/7 mode, is fully licensed according to German BImSchG and is designed to run on standard SRF (Solid Recovered Fuel) derived from Municipal Solid Waste (MSW). The liquid resource has been registered under REACH regulations proving its End-of-Waste-Status and has successfully been used as a fuel and as a feedstock for new polymer production. Evaluating the fields of application, CARBOLIQ cooperates with international off-take partners for its Circular-Liquid-Resource (CLR).



Fields of Application for CARBOLIQ Circular Liquid Resource

## Process

CARBOLIQ technology is a continuous single-stage catalytic liquefaction process. It is characterized by its applicability to a variety of feedstocks i.e., mixed and contaminated waste plastics, generating a constant, feedstock independent, high energetic, universal useable crude oil substitute. Operating at temperatures of less than 400 °C and at atmospheric pressure, there is no coking and formation of pyrolysis gases. Depending on the feedstock composition, the yield rate is up to 90% mass. Applying friction as the major source of energy, consumption of electricity is around 1 kWh/kg mixed waste plastics. With all process energy counted for, the net efficiency of 84% remains unbeaten to other conversion technologies. The process is certified according to the sustainability criteria of ISCCplus.



## Balancing

Operating a pilot plant in industrial size and mode, CARBOLIQ, generates comprehensive data enabling closed mass, material and energy balances to be drawn up. There is a qualified verification ongoing by independent experts. Results are expected to be available by end of 2022. Based on

preliminary life cycle analysis a ton of r-plastic produced by the use of CARBOLIQ-CLR reduces CO<sub>2</sub> emissions by at least 45% compared to incineration. With the process only powered by electricity coming from sustainable production, the process can be validated to have no CO<sub>2</sub> emission and savings will go up to >60%.

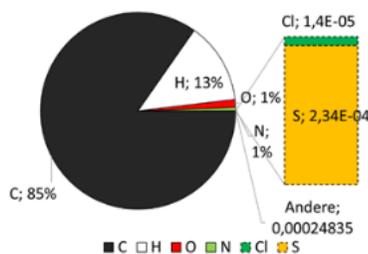
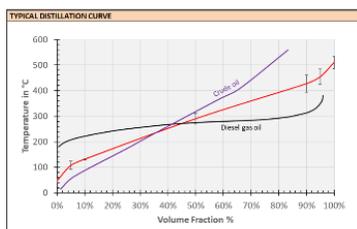
## Feedstock

CARBOLIQ technology has been successfully applied to hard plastics as well as films and foams. Campaigns have been run on SRF (incl. paper >20%), multilayer film (incl. PA > 50%) and mixed plastics (incl. PET > 40%). In contrast to other pyrolysis processes, CARBOLIQ can handle significant contents of PVC or ABS containing flame retardants. Up to a certain degree it is robust to handle contaminants (metals, stones, glass, etc.) as they are typical to waste. The size of feedstock is limited to 2D: max. 40mm or 3D: max. 5mm. Humidity should not exceed 18%.



## Circular Liquid Resource

CARBOLIQ CLR is a storable, multi usable, liquid resource consisting of a mixture of hydrocarbons. It is appropriate to be used as alternative resource for the chemical or petrochemical industry or as combustible. Depending on operations mode and feedstock composition, the peak of the distribution of hydrocarbons ranges from C<sub>8</sub> to C<sub>22</sub>. Typical density is 825 kg/m<sup>3</sup>. The Higher Heating Value is >44.500 kJ/kg.



CLR is shipped in ISO-Containers for processing in Refineries or Steam Crackers. Typical batches are 22 tons. According to **REACH** regulations, CARBOLIQ CLR is registered as a UVCB substance. It is declared to be an intermediate and requires handling and storage under strictly controlled conditions. According to German legislation CARBOLIQ CLR is qualified to be **End-of Waste!**

## System

The pilot plant is in continuous (24/7) operation. It is operated by CARBOWEST, a joint venture with ECOWEST, a public company running the waste site in Ennigerloh, Germany and providing Solid Recovered Fuel (SRF) to cement industries. By running campaigns of significant volume on different feedstock, CARBOWEST demonstrates CARBOLIQ technology to be TRL 8 and generates data and experience for scale up. Next generation modules are planned to have an annual capacity of 10.000 tons output.



## About CARBOLIQ

CARBOLIQ GmbH is a technology platform owned by Recenso GmbH, Südpack Holding GmbH and Cycle Investment BV. Focus is on Resource Regeneration. CARBOLIQ will build and operate conversion plants where feedstock is available. It will serve the industry with a Circular Liquid Resource it suitable to be processed in existing facilities. CARBOLIQ is open for cooperation with all stakeholders contributing to circular value chains.