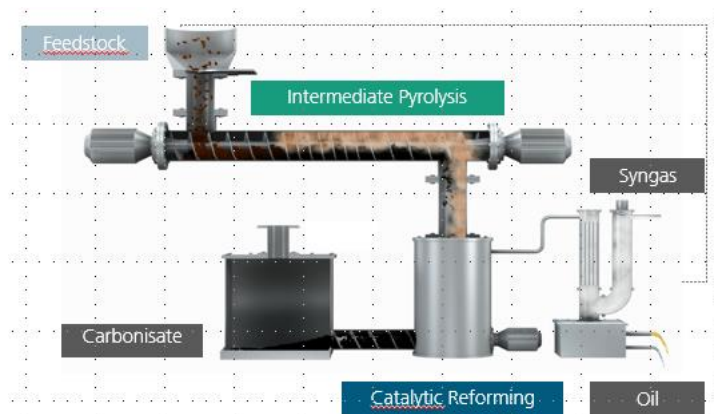


## Green Crude Oil from Residual Biomass [TCR technology: CO<sub>2</sub>-neutral energy sources from biogenic waste]

Biomass combustion, gasification and conversion generally have to contend with restrictions regarding the range of possible input materials, compliance with emission standards and overall energy efficiency. Fraunhofer TCR technology can be used to convert a broad spectrum of biogenic residual and waste materials into storable energy sources. These products are the starting point for, next-generation synthetic fuels or basic materials for the chemical industry. Waste biomass is converted to oil, gas and coal in the TCR process. The oil corresponds to a fossil crude oil and can be processed into fuels or chemical raw materials.

**Technology: Thermo-Catalytic Reforming (TCR)** : In »thermo-catalytic reforming« (TCR® process), residual biomass is converted into synthesis gas, carbonate and liquid bio crude oil, which forms the starting material for synthetic fuels. **In a first stage**, the biomass is gently broken down into biochar and volatile components in a continuously operating screw reactor in the absence of oxygen at medium temperatures (< 500 °Celsius). The formation of tar and other pollutants is prevented by optimized process conditions in the various reactor zones. **Second stage**: In a post-reformer, the coal and vapors are catalytically refined further at temperatures of up to 700 °Celsius to improve gas yield and product quality. The vapors are then cooled. During condensation, oil and process water are separated. The remaining gas is cleaned.



The TCR process converts biogenic feedstock into oil, synthesis gas and carbonate.



**Three products: oil, gas, coal:** Synthesis gas, a dust-free product gas with a very high hydrogen content, which can be

The CO<sub>2</sub>-neutral oil from the Fraunhofer TCR process can be processed into standard-compliant fuels.

up to 50 percent. Carbonisate (»biochar«) with a high carbon content, which is used in-situ as a catalyst in the TCR process itself, can serve as a soil conditioner or can be stored. A pyrolysis oil with a petroleum-like consistency, which has a high calorific value and very low acid values (comparable to vegetable oils). It can either be refined together with mineral crude oil in refineries (co-processing) or further processed into products such as petrol and diesel. The new development and optimization of downstream process routes for mineral oil substitutes, e.g. pyrolysis oils, synthesis gases, halogenated hydrocarbons or Fischer-Tropsch products, plays a major role here.

**Climate-neutral crude oil:** The resulting products are climate-neutral. The energy required is generated from the residues used, so there are hardly any CO<sub>2</sub> emissions in the process. The input materials themselves, by definition, have no »CO<sub>2</sub> rucksack« (unlike biomass, which also has a small proportion of CO<sub>2</sub> emissions due to cultivation). The coal can be introduced into soils as long as the feedstock is not contaminated. The carbon contained in the coal is then permanently removed from the atmosphere. (The coal from the TCR process is extremely stable due to the low oxygen and hydrogen contents and is not decomposed in the soil). If the carbon is sequestered in this way, the products, i.e. the oil and gas, get a negative CO<sub>2</sub> balance. In the case of fuel production, the hydrogen required from the feedstock is also provided by the synthesis gas. This means that the fuels produced by the TCR process also have an almost neutral CO<sub>2</sub> balance.

The TCR technology was developed for a containerized, compact plant design. The technology thus represents a decentralized solution for the recycling of biogenic residues of various kinds all over the world.

*Fraunhofer is one of the world's largest applied R&D organizations, with nearly 80 research units in all sectors of industry, 30000 employees and an annual outlay of Euros 2.9 billion. Of this sum, 2.4 billion euros is generated through contract research. Our global footprint is very strong, with offices and research centers in the Europe, USA and Asia. Some of our renowned innovations are the MP3 format, the white LED, the smallest of cameras. Fraunhofer covers the entire spectrum of energy (Renewables, Storage, E-Mobility, Grid, Hydrogen...) across the value chain from materials to testing and certification. Fraunhofer has been active in India since the past several years, bringing innovative technologies and research competence to India. Fraunhofer in India is the chosen R&D and innovation technology partner of some of the major players in the field of Energy, Environment, Automotive, Electro-mobility, Materials, Production Technology and Smart Cities working with Industry, Government and Public Sector. >>[CLICK HERE](#)<< to receive more info on this TechFlash.*

Kindly get in touch with us if you are interested in this technology or require further information.  
Thanks and Regards,

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