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Trend Study Waste-to-Fuel

Background – Plants – Projects – Competition

Extract

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Trend Study Waste-to-Fuel

In many cases, electrically powered vehicles will be used for decarbonising the mobility sector. Wherever electromobility will not work in the foreseeable future, e.g. for aviation or shipping, sustainable fuels will be needed.

For the time being, most sustainable fuels are based on biomass. However, those are finite and increasingly criticised, even from an ecological point of view – examples are "plate or tank" discussions and the destruction of primary forests.

Producing fuels from waste instead could make a significant contribution in this regard. Such a production promises the use of biomass (and to some extent of plastic, as well) after its original economic purpose has been fulfilled. As a result of this promise, there are numerous efforts to enable such a production of fuels both in technical and economic terms.

With our new trend study, ecoprog has analysed such waste fuels.

Specifically, the Trend Study Waste-to-Fuel includes:

- A description of the essential technologies and functionalities of the production of waste fuels.
- An analysis of the most important market factors as well as a fundamental discussion of the waste streams that could be used.
- An evaluation and presentation of around 60 plants and projects worldwide, including a description of the market participants, capacities, input material, and fuel to be produced (if known).

The study does not evaluate: biogas and biomethane from the anaerobic digestion of organic waste, hydrogen and e-fuels from electrolysis, as well as renewable fuels from residues, oils, and fats.

The study is available **starting from 1,600.– €** (plus VAT, if applicable)**.** Customers of our w&b Monitor receive a discount of 600.– €. You will find detailed information on prices and ordering on the last page of this extract.

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Contents

List of figures

Even though dimethyl ether (C_2H_6O) is not an alcohol, it is an organic compound from the group of ethers, which also consists of H, C, and O and is basically suitable for diesel engines, like methane.

The elements contained in them share alcohols with many other organic compounds. One characteristic of alcohols is that they contain one or more hydroxy groups bonded to different aliphatic carbon atoms.

2.1 Waste-to-Fuel segments that will not be analysed

From a technical point of view, there are some types of fuel production from waste that are not always referred to as Waste-to-Fuel; most of them will not be analysed in this study. These are:

- biogas and biomethane from the anaerobic digestion of organic waste,
- hydrogen and e-fuels from electrolysis,
- renewable fuels from residual materials,
- renewable fuels from oils and fats.

2.2.1 Biogas and biomethane from anaerobic digestion

The most common way of using waste as a fuel is using biomethane.

Biomethane is produced from biogas, coming from biogas plants. Today, roughly 20,000 biogas plants are active worldwide. Most of them ferment agricultural residues such as manure, and many of them are very small.

Other plants use "renewable raw materials" that are grown specifically for this purpose. e.g. maize or wheat.

Only a minority of biogas plants use waste as input. The main types of waste used are:

- Largely homogeneous biological waste from food and feed production, e.g. from dairies.
- Other separately collected organic waste, such as canteen and restaurant waste or unsold products.
- Separately collected household waste from organic waste bins.

In some countries, e.g. France or Spain, there are also facilities that ferment mixed waste, such as municipal residual waste, in biogas plants. For this purpose, the mixed waste is either pre-sorted, or the fermentation is carried out together with the non-organic components.

- Waste from agriculture and forestry, including processing plants such as dairies;
- waste from wood processing,
- waste from packaging,
- municipal waste and
- pre-treated waste.

The waste categories mentioned accounted for around 130 million tonnes of waste in Germany in 2022. These were classified in almost 250 of the overall 900 subcategories.

However, not all waste in these categories can be considered as suitable, not even in principle or without any further technical consideration. Pre-treated waste includes, for example, rust ashes from waste incineration. Municipal waste also includes scrap glass, while agricultural waste includes pesticide residues.

After eliminating these obviously unsuitable subcategories, around XX million tonnes of waste remain, which – without any detailed examination – are generally interesting for the production of fuels.

Of this amount, about XX million tonnes are municipal residual waste, i.e. mixed waste (20030101), as well as sorting residues from the mechanical pre-treatment of mixed waste (191212). Other large amounts can be found in municipal sewage sludge and separately collected organic waste from the municipalities, either from organic waste bins or from other sources.

In terms of waste quantities, municipal waste dominates obviously, as these occur in larger quantities and throughout the country. Waste volumes from individual industries, e.g. sawdust or sludge from the paper industry, are smaller than the aforementioned types of waste.

Figure 15: Suitable waste streams, 20 largest streams in Germany

EAV code	Description	Quantity, in million tonnes
20030101	Household waste, commercial waste similar to household waste	10.25
191212	Sorting residues from mechanical pre-treatment	10.01

- Location: If a location was selected (even if no approval has yet been granted), this was rated positively (1 point).
- Approval: If there is information on the permit for the construction of the plant, this was rated positively (1 point).
- Established players: If the relevant project developers (especially the operators-to-be and/or major technology providers) are larger corporations, this was rated positively (1 point).
- Value chain: If potential partners are involved in the value chain (possibly also as investors) – e.g. waste companies for the delivery of the waste or airlines as buyers of the fuel –, this was rated positively (1 point).
- Public funding: If a project was granted public funding (after a proper evaluation), this was rated positively (1 point).

Figure 21: Ranking of Waste-to-Fuel projects

Points	Name	Input capacity, tpy	Output capacity, tpy	Start of operation
4		n.a.	179,000	2030
3		700,000	60,000	n.a.
3		1,000,000	86,600	2028
3		10,000	n.a.	n.a.
2		40,000		2025
2		690,000	n.a.	n.a.
2		180,000	90,000	n.a.
2		35,000	1,750	2024
2		n.a.	n.a.	n.a.
2		n.a.	n.a.	n.a.
2		n.a.	n.a.	n.a.
2		n.a.	n.a.	n.a.
2		1,000,000		n.a.
2		600,000	80,000	2027
2		500,000		2028
2		350,000	245,000	2026
2	Varennes	200,000	n.a.	
2	Vohburg	100,000	n.a.	n.a.
2		100,000	n.a.	n.a.
2		12,775	n.a.	n.a.
2		360,000	240,000	2026
1		n.a.	n.a.	n.a.
1		260,000	n.a.	n.a.
1		200,000		n.a.

(…)

7. Competition

The main competition in the waste-to-fuel segment can currently be characterised as a race to develop a commercially successful technology. A real market with different suppliers of commercial products does not yet exist; consequently, there are no market leaders.

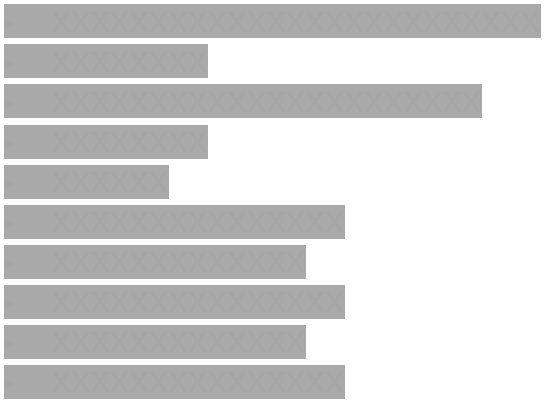
Today, there are mainly two larger groups of actors: start-ups and (...). In addition, there are individual other actors, e.g. from (...) or (...).

(…)

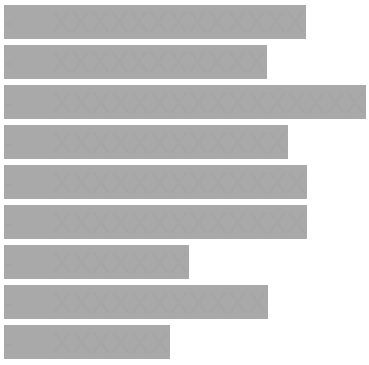
Start-ups

In recent years, start-ups such as Enerkem or Fulcrum have shaped and driven the Waste-to-Fuel market. In this study, start-ups are defined as companies with Waste-to-Fuel as their core activity; many of them were founded to develop this technology in the first place.

This group includes, amongst others:



- Enerkem
- Fulcrum



- (…)

Parque de la Carpetania, Spain

Operator / developer: Artemisa Sustainable Fuels SL

Status: discussed

Input type: urban and industrial waste
Input capacity (t/a): 690.000
Type of output: SAF

Remarks: Partners include Abengoa, Airbus, Aurea Capital Partners, BP, the National Hydrogen Center, CIEMAT, and SENASA.

Picassent, Spain

Operator / developer: Remittel

Status: planned

Input type: Residuals from the food industry, sewage sludge, industrial waster and used oils

Type of output: Biodiesel

Technology owner:

Remarks: The investment is expected to amount to EUR 10 million

Bangkok, Thailand

Operator / developer: Chulalongkorn University

Status: active
(Planned) start of operation: 2022

Input type: plastic waste
Input capacity (t/a): 1.278
Type of output: diesel
Output capacity (t/y): 600
Main technology: Pyrolysis

Remarks: The Provincial Electricity Authority (PEA) provided funding for the research project. Plant processes 3.5 tpd of plastic waste into 2,000 litres of diesel fuel daily.

AURAK & ASGE, UAE

Operator / developer: American University Ras Al Khaiman (AURAK), Al Shrooq Green Energy (ASGE)

Status: discussed

Prices and product information

You can order the study at:

https://ecoprog.com/order/waste-to-fuel

Prices:

- Single-user version, 1,600.– €*
- Company version, 3,200.– €*
- Corporate version, price on request

Product information:

Single-user version:	Personal copy (personalised and password-protected PDF file, sent via email).
Company version:	Company-wide copy (legal entity), PDF file, sent via email.
Corporate version:	Copies for different, but legally connected companies (e.g. sister companies, investments abroad). The price depends on the number of companies and persons.

Subscribers of ecoprog's waste & bio Infrastructure Monitor will receive a discount of 600.– € (1,200.– € discount in case of a company version).

Find all our prices at a glance in our here.

* plus 19% VAT for customers within Germany and EU customers without a VAT ID.

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