

# Summary

*Prognos study:*

## “Perspectives for thermal waste treatment - Roadmap 2040”



**ITAD**

ITAD - “German Association of Waste-to-Energy Plants” represents far over 90 percent of the German thermal waste treatment capacities

[www.itad.de](http://www.itad.de)

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## Thermal waste treatment: Plants will continue to operate at full capacity until 2040

In the coming years, many municipal and private owners of thermal waste treatment plants<sup>1</sup> (WtE) will have to make decisions on the replacement or modernisation of individual incineration lines or entire plants. Against the background of the high investment costs and the long-term nature of the decisions, discussions have been taking place at many individual sites, but also in the form of nationwide considerations, for some time now. The question is how much capacity or plants will be necessary in Germany in the future in order to be able to guarantee long-term security for the disposal of municipal, commercial and industrial waste.

Against this background, the German Association of Waste-to-Energy Plants (ITAD) has commissioned Prognos AG in cooperation with Prof. Martin Faulstich to prepare the present study “Perspectives for Thermal Waste Treatment – Roadmap 2040”<sup>2</sup>. The roadmap describes the development of the utilisation of the plants up to the year 2040 and considers the foreseeable changes in the range of tasks of thermal waste treatment from different perspectives

The research results obtained can be summarised in the following 9 theses.

### 1. The thermal waste treatment plants will continue to operate at full capacity until 2040

The analyses and forecasts of volumes and capacity developments for the period up to 2040 are naturally subject to certain fluctuation margins. Uncertainties arise, for example, from unforeseen developments that lead to a significant decline in economic output. A significant reduction in the volume of commercial and industrial waste was observed as a result of the global economic crisis in 2008 and is also now evident in the corona crisis. After such events, however, the volume of waste generally returns to the “pre-crisis level”, so that the effects on long-term developments are likely to be slight or unsustainable.

This study only considers those types of waste that are relevant to WtE primary competitive market<sup>3</sup>. The total volume of these waste types treated in the plants belonging to the primary competitive market amounted to 34.51 million t(tonnes) in 2017, of which 26.17 million t were recovered for energy in WtE and to a small extent also disposed of.

The conservative accounting of the relevant waste types and the available capacities comes to the conclusion that full capacity utilisation of WtE can be expected at least until 2040. The forecast for the relevant waste types shows a decline in waste volumes from 34.51 million t to 33.44 million t in 2040.

This is the result of the following three developments, which will run parallel to each other on the timeline:

- The volume of municipal waste for thermal treatment as well as commercial and industrial waste will rise from 34.51 million to 36.76 million t by 2040 in the status quo forecast solely on the basis of demographic and economic development. The extrapolation of the status quo for 2017 does not take into account the effects of any waste management measures.

*1 For the purposes of this study, this term covers waste incineration plants (WIP) and refuse derived fuel power plants (RDF)*

*2 Due to its long-term perspective, this study does not take into account the short and medium-term economic and social effects of the corona crisis. Furthermore, it is not yet possible to foresee the overall impact on the waste management industry*

*3 In addition to the WtE, the primary competitive market of WtE also includes pro rata capacities of cement and coal-fired power plants (provided that comparable waste fractions as in the WtE) and M(B)T, which still have residual waste contracts*

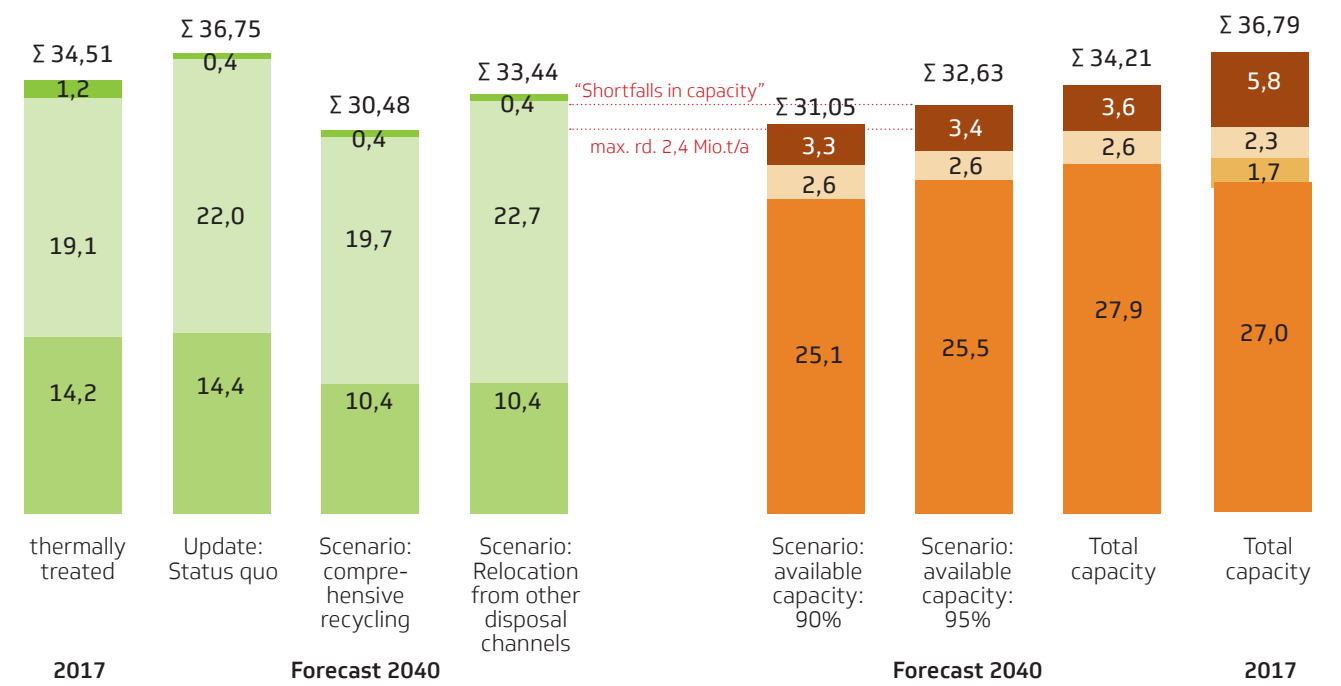
- The implementation of various waste management regulations leads us to expect a reduction in the relevant waste volumes of 6.28 million t by 2040. A much more comprehensive recycling will reduce the volume potential for WtE from 36.76 million t to 30.48 million t by 2040.
- The change in the legal classification of waste and the shift of material flows from other disposal routes will result in additional waste volumes of at least 2.96 million t being available for WtE by 2040. There is no alternative to thermal treatment with energy recovery for this volume potential. This increases the total quantity of waste for energy recovery to 33.44 million tonnes in 2040.

The potential of the relevant waste quantities for the WtE will decrease by a total of 1.07 million tonnes by 2040 as a result of the developments described above.

Figure 1: Comparison of results of waste volume forecasts and capacity considerations

Waste quantities (primary competitive market WtE)

Capacities (primary competitive market WtE)



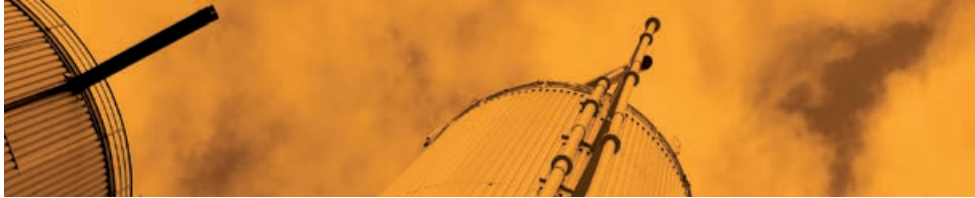
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- Imports (AW 191210, 191212, 20030)1
- Industrial and commercial waste
- Waste from households

- M(B)T\*\*
- Cement plants\*
- Coal-fired power stations\*
- Thermal waste treatment plants (WtE)

\* Consideration of proportional capacities for comparable waste fractions that are typically thermally treated in waste incineration plants and RDF power plants

\*\* Consideration of the capacities of mechanical-biological, mechanical-physical and mechanical treatment plants that currently still have contracts for municipal residual waste quantities



The total capacity for the recovery of the waste quantities relevant for the WtE will decrease by a total of 2.58 million t/a from 36.79 million t/a to 34.21 million t/a by 2040. While thermal treatment capacities are expected to increase slightly, the decline is mainly due to the loss of capacities for the co-incineration of secondary fuels in coal-fired power plants and the closure/conversion of mechanical (biological) treatment plants (M(B)T).

In relation to the total capacities under consideration, this results in low free capacities of 0.77 million t/a compared to the relevant waste volumes of 33.44 million t/a. However, this is only a theoretically available estimate. If a capacity reserve of only 5 % for maintenance and inspection times, heating value fluctuations, etc. is taken into account for the capacity analyses, the result is a capacity shortfall of 0.81 million t/a. Realistically, however, on the basis of decades of operating experience, a reserve of 10 % of total capacity should be set aside in order to be able to provide for short-term special occurrences due to unforeseen weather events or above-average accumulation of health waste. In this case, the calculated capacity deficit would rise to 2.39 million t/a in 2040.

The overall result of the different considerations is full capacity utilisation at least until 2040, but from today's point of view a lack of capacity is more probable if no further additions are made beyond the plans already known today.

## 2. The thermal waste treatment plants guarantee safe disposal

At present, a total of around 100 WtE in Germany guarantee waste disposal security for households, industry and commerce. This is a very important aspect, which has not played a special role in public discussions for more than 15 years due to the habituation to continuously available capacities and functioning logistics. An important function of WtE is that of a pollutant sink - high-quality recycling is only possible if pollutants can be removed from the material cycles.

Within the framework of ensuring waste management security, the system relevance of WtE is also evident. This means that the plants are available in critical situations for qualified (special) disposal measures for a specific, possibly temporarily higher volume of waste. This may include waste from the health care sector (hygienisation), waste from extreme weather events or the removal of dangerous pests. Against this background, local decisions on the development of future capacities also have a major influence on the specific disposal security of the surrounding regions.

## 3. The thermawaste treatment plants ensure security of energy supply

In order for cities and regions to be largely climate-neutral in the future, WtE will have to make an important contribution by providing electricity, district heating, process steam and – depending on development – hydrogen. This contribution will also include energy system services, for example for network stability, which will become necessary as part of the energy system transformation. In addition, WtE also ensures security of supply for industrial parks and energy-intensive companies through waste heat recovery. Feeding into local district heating networks will become more important as inner-city or near-city coal-fired power plants are taken off the grid. WtE total energy supply of electricity, district heating and process steam amounts to more than 30 million MWh p.a. The intensive use of WtE waste heat and the substitution of fossil fuels not only has positive effects on the





climate balance, but also reduces the most important air pollutants (particulate matter, nitrogen oxides, etc.) through compliance with the highest environmental standards in waste gas purification.

#### 4. The thermal waste treatment plants are continuously modernised

The approximately 100 WtE in Germany consist of over 200 incineration lines. The average line age<sup>4</sup> of the plants is about 23 years, while that of the RDF power plants about 11 years. Based on an assumed age for a fundamental refurbishment of 35 years, there is a theoretical need for modernisation of about 14.7 million t of WtE capacity by 2040, which corresponds to about 55 % of the total capacity. However, the assumed modernisation period of 35 years does not allow a direct conclusion to be drawn from the age of individual plants to their actual modernisation needs. Until the time of a comprehensive refurbishment, the WtE are permanently maintained, optimised and adapted to the current state of the art and environmental law. Only when the main parts (e.g. the boiler or the flue gas cleaning system) reach a certain age the replacement is carried out. The question of how the existing capacities at WtE will develop over the next few years is determined not least by the costs of maintaining the (thermal) infrastructure. On the basis of current information on the respective modernisation costs by line size, the average cost is currently around €75 million, based on an average capacity of 100,000 t/a. These average values result in a calculated total investment requirement of around € 11 billion by 2040.

#### 5. The thermal waste treatment plants support the recycling of household and commercial waste

High-quality recycling and further development towards closed material cycles will only be possible if there are also secure pollutant sinks in the form of WtE. Furthermore, in recent years it has been shown that sustainable recycling structures in Germany can also be influenced by external influences in the short term, for example by the import restrictions on plastics and plastic waste imposed by China, the lack of recycling capacities in the EU or market distortions due to volatile raw material prices. Therefore, from the point of view of the WtE operators, efforts for more sustainable recycling are both sensible and necessary in order to create free capacities in the medium and long term for the additional waste to be thermally treated from environmental protection measures, changed hazard classifications, pollutant discharges and hygienisation. WtE also make a direct contribution to material recycling. Within the framework of slag processing, innovative technologies already make it possible to collect ferrous and non-ferrous metals which have not been collected separately (e.g. misplaced waste, metals in sorting residues) or which cannot be separated from composite materials without further processing (e.g. metals in composite materials) and to recover them even in the smallest grain sizes. In addition, the mineral fraction is also processed and can be used as a substitute building material in technical structures.

#### 6. The thermal waste treatment plants contribute to climate protection

In 2019, the WtE that are members of ITAD emitted around 9.5 million t of CO<sub>2eq</sub> in 2019 through the incineration of around 24.1 million t of municipal, industrial and commercial waste and the use of small amounts of fossil fuels (e.g. gas and oil for pilot and support burners). The substitution of electricity, process steam and district heating from fossil primary energy sources in the order of 32 million MWh saved around 13.5 million t of CO<sub>2eq</sub>. In addition, around 1.2 million t of CO<sub>2eq</sub> were saved by recycling metals. On balance, this

<sup>4</sup> related to the last boiler modernisation



corresponds to a saving of around 5.2 million t of CO<sub>2eq</sub> through the operation of the ITAD member facilities alone. As the basis of a functioning circular economy, WtE also ensure that considerable potential CO<sub>2eq</sub> savings can be achieved in other areas of the recycling economy. For example, the establishment of sufficient capacities in thermal treatment plants was the prerequisite for the possibility of closing the landfills for untreated waste. This has not only led to a technological leap in waste management but has now also led to savings of around 30 million t of CO<sub>2eq</sub> compared with 1993. WtE are also indispensable for the operation of mechanical-biological treatment plants allowing the energy recovery of the residues and high-calorific-value fractions resulting from sorting.

## 7. The thermal waste treatment plants extend the municipal scope of action

In order to bring about positive investment decisions in the coming years, it will be important to present WtE current and future range of tasks in a way that is comprehensible to the public, politicians and decision-makers. WtE responsibility for the modernisation and maintenance of the existing infrastructure does not only apply to the narrower area of waste disposal and energy supply, but is also in the overall interest of the municipalities and the economy, owing to the system services it provides. The maintenance and modernisation of existing capacities is necessary for various reasons. In areas that have no plans for future thermal treatment facilities, there are fewer options for action regarding optimising:

- the regional waste management industry and waste disposal safety,
- the local energy supply and supply security,
- the recycling industry and
- a sustainable infrastructure development.

WtE is also an important employer and taxpayer in the cities and regions. In the entire market segment of energy recovery from waste, around 18,500 employees with a wide range of qualifications currently find secure and sustainable jobs. Further positive effects are also generated by investments and the awarding of contracts for services to the local economy and the skilled trades.

## 8. Thermal waste treatment plants are an important part of the Green Deal in the European recycling industry

In view of the EU's current "Green Deal" policy, there will probably (have to) be new initiatives to close landfills in Europe earlier than foreseen. The reduction of climate-relevant emissions from landfilling and recycling can be much cheaper than measures in many other sectors of the economy (significantly lower costs of CO<sub>2eq</sub> avoidance). The establishment of orderly material and energy recovery structures, especially in Eastern and Southern Europe will take some time. For this transitional period German WtE will also be available for energy recovery within the framework of the European division of labour, provided that free capacities are available and the measures are economically viable. Here, the German environmental services branch can point out perspectives for other European and non-European countries and thus also provide impulses for the export of German mechanical and plant engineering products and services.

## 9. The thermal waste treatment plants support the way to a climate neutral Germany

The idea of the Circular Economy is based on the ideal of closed raw material cycles. The reduced use of raw materials for the production of goods and energy results in clearly positive effects for climate protection. With the increasing focus of politics and economy on the Circular Economy as a new model of environmental and economic policy, considerations on the integration of thermal treatment plants into the complex system of raw material saving are an important step towards future climate neutrality. Today, WtE makes a positive contribution of 5.2 million t (ITAD member plants only) of avoided CO<sub>2eq</sub> emissions, which results primarily from the electricity credits. However, with an increasing share of renewable energies in the electricity mix in Germany, the credits are becoming smaller, therefore even a negative impact is to be expected in the period under review. However, this also depends largely on the development of the heat supply (credits for district heating and process steam) and the long-term composition of waste (biogenic plastics, carbon recycling, etc.). The main cause of CO<sub>2</sub> emissions from WtE is the incineration of plastic components found in municipal and commercial waste and sorting residues. The possibility of further increasing the contribution of WtE to climate protection will also depend, among other things, on the extent to which industry (e.g. the food industry, but in particular the chemical industry) succeeds in substituting its carbon requirements with non-fossil sources<sup>5</sup> or in covering them with recycled carbon. The separation of CO<sub>2</sub> from the clean gas of the thermal plants and the further use of carbon (CCU)<sup>6</sup> can and will make a positive contribution to carbon management in the long term and climate-relevant emissions from the thermal treatment of waste will continue to fall. Almost all operators of thermal treatment plants deal with electrolysis. If the framework conditions change, feeding hydrogen into separate H<sub>2</sub> networks<sup>7</sup> or direct use by hydrogen vehicles can become economically interesting.

### Info

Over the last 125 years, the thermal waste treatment plants have continuously changed their tasks within the provision of services of general interest but have always proven their *raison d'être*. Today, investments in thermal waste treatment plants are not simply “only” investments in waste disposal, but rather in multifunctional technical infrastructure facilities. Within the framework of their corporate responsibility, the operators of thermal waste treatment plants will continue to ensure that they are able to meet the various social, economic and political demands on waste disposal, energy supply, resource and climate protection for the next 20 years and beyond.

<sup>5</sup> DECHEMA 2019

<sup>6</sup> Carbon Capture and Utilization

<sup>7</sup> GET 2020