Confederation of European Waste-to-Energy Plants

WASTE-TO-ENERGY CLIMATE ROADMAP

The path to carbon negative

CONTENTS

INTRODUCTION

This document complements the first Waste-to-Energy Sustainability Roadmap, which CEWEP published in 2019 [1]. The 2019 Roadmap highlighted that even when the 2035 targets of the Circular Economy Package are reached (10 % cap for landfilling and minimum recycling target of 65 % for municipal waste), there will be still the need to treat residual waste that cannot be recycled in an environmentally-sound way.

Waste-to-Energy (WtE), or the incineration of residual waste with energy recovery, is an essential cornerstone of a sustainable circular economy and a key contributor to achieving the European Green Deal's climate objectives (55 % reduction of greenhouse gas emissions by 2030, climate neutrality by 2050). In light of these objectives, this updated roadmap explores how the WtE sector will help Europe achieve net zero emissions.

To better understand the main assumptions and the methodology adopted in this Roadmap the reader should consult the separate Technical Annex (TA), available on CEWEP website.

This work was peer-reviewed by Thomas Højlund Christensen, Professor at the Technical University of Denmark (DTU), in May 2022.

WtE: providing a sanitary service while contributing to climate mitigation

1

WtE plays a double role in society.

First and foremost, WtE serves a hygienic function by treating the residual waste that cannot be prevented or recycled. WtE takes responsibility for the remaining waste streams produced by citizens and businesses.

Furthermore, by treating the residues created from sorting and recycling activities, WtE plants act as a reliable sink for pollutants – a role that will only grow when society increases the use of high quality recycling. WtE will continue to optimally complement material recovery activities by promoting quality recycling.

It is important to remember that WtE's sanitary service is just as necessary today as it was in the past. In the past, waste was burned as a means of dealing with infectious diseases like cholera. Even though we have come a long way since then, hygiene and health are still strongly related – a fact that has become all too clear during the COVID19 pandemic. Some sanitary items cannot be reused or recycled, and it must be ensured that viruses are safely destroyed.

Secondly, while guaranteeing a continuous sanitary service to communities and industries, WtE facilities use the energy contained in residual waste to maximise energy generation, including the production of electricity, heating, and cooling.

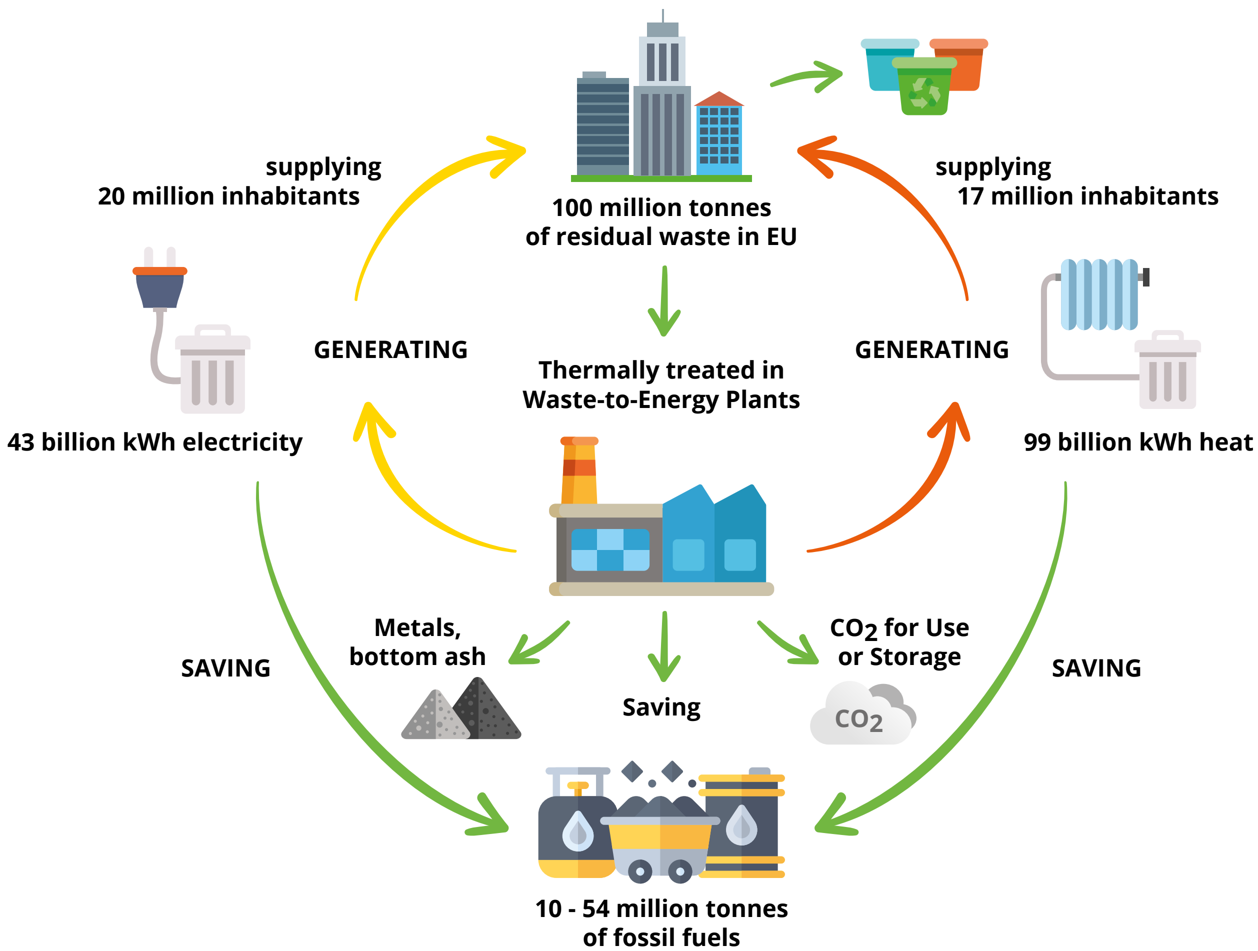

Figure 1: WtE's contribution to the energy cycle annually – Source: CEWEP data, 2019

Key Waste-to-Energy numbers

European WtE plants produce **enough electricity to supply almost 20 million people per year**. Additionally, in Europe, WtE plants can provide around **17 million people with heat annually**.

More than 60% of WtE plants in Europe are combined heat and power (CHP) plants. CHP plants provide heat to urban district heating and cooling networks.

WtE can serve as a local source of baseload (24/7) energy that complements intermittent renewable energy sources. In doing so, these same plants help make Europe less dependent on fossil fuel imports.

The amount of primary energy generated by WtE in 2019 was equivalent to 13.8 billion m³ of natural gas. This corresponds approximately to 9 % of the natural gas imports to the EU from Russia (155 billion m³ in 2021).

Assuming that the Circular Economy targets are applied not only to municipal waste, but also to commercial and industrial waste, by 2035 WtE plants could produce 189 billion kWh of useful energy per year. This would be equivalent to 19.4 billion m³ of natural gas in terms of primary energy.

WtE plants also bring considerable climate benefits. For example, WtE plants provide steam that can be used by neighbouring industrial companies as an alternative to traditional fossil-fuelled boilers.

Today, around **10% of Europe's district heating energy comes from WtE**. In some urban areas, energy from waste covers **more than 50% of residential heat demand**. This represents a significant contribution to energy security and air quality, as residents avoid using individual boilers for heating. In large district heating networks, WtE can take on the role as the primary source of baseload heat. As a result, WtE can facilitate the integration of smaller renewable sources such as geothermal energy and power-to-heat.

The importance of integrating WtE into district heating and cooling networks has been noted in some recent assessments by the **Joint Research Centre of the European Commission** [3] [4] [5]. Furthermore, numerous success stories can be found at the local level (Milan, Barcelona, Brescia, Malmö, Klaipėda, Vienna, Brussels, Paris, Port of Antwerp, etc.).[5] [6]

While in the future, the electricity grid will see a higher penetration of renewables, the heat sector will be much more difficult to decarbonise [2]. As demonstrated by many examples in European cities [3-7], the coupling of WtE with district heating and cooling systems will deliver great climate contributions by allowing for an ambitious integration of waste heat recovery and energy systems.

New District Heating installation at the IMOG WtE Plant, Belgium. © IMOG

Apart from the CO_2 emission savings that can be achieved by substituting fossil fuels with WtE, WtE can further contribute to reducing GHGs by facilitating landfill diversion, meaning that waste is redirected from landfills to treatment routes higher in the waste hierarchy. That's because decomposing waste in landfills generates methane – a greenhouse gas that is 28 times more potent than CO_2 on a 100 year perspective and 86 times more on a 20 year perspective. [8]

"Diversion from landfill is the main contributor to GHG mitigation in the waste management sector."

German Federal Environment Agency [10]

Despite recent progress on recycling rates, Europe still landfills almost **60 million tonnes of municipal waste annually** (**24% of the total municipal waste treated in 2019**) and significantly more when commercial and industrial waste is included **(ca. 100 million tonnes of non-inert waste per year).**

"Methane is one of the gases we can cut fastest. Doing that, we'll immediately slow down climate change."

Ursula von der Leyen, President of the European Commission [13]

Landfills can be found across Europe and represent a major hurdle in countries that still lack an integrated waste management infrastructure, such as in Southern and Eastern Europe. The panorama of waste management in Europe can be very diverse. For some, one of the biggest challenges of the coming decades will be figuring out how to reduce landfilling. In Spain, for example, the amount of waste destined for landfills is much higher than the European average. As of 2018, the main management system for Spanish municipal waste was still direct disposal at landfill sites, which receive 56.3% (12.7 million tonnes) of the total waste generated, while recycling is 33.8% and energy recovery 9.9%. [12]

The urgent need to tackle methane emissions from landfills

A recent UN Report - *Global Methane Assessment - Summary for Decision Makers* [9] suggested that the largest potential for mitigating methane emissions can be found in Europe's waste sector. Methane's short atmospheric lifetime means acting now can quickly reduce atmospheric concentrations and result in similarly rapid reductions in climate change and ozone pollution. Because of its high Global Warming Potential, mitigating methane has the greatest potential to decrease global warming over the next 20 years.

On 2 November 2021, at the United Nations Climate Change Conference in Glasgow (COP26), more than 100 countries joined a US and EU-led coalition to cut methane emissions by 30% by 2030 (compared to 2020 levels).

European Space Agency satellites detect large methane emissions coming from Madrid landfills

Using data from the Copernicus Sentinel-5P mission, combined with GHGSat's high-resolution commercial imagery, scientists from the Netherlands Institute for Space Research and GHGSat discovered that two landfill sites near the centre of Madrid emitted a combined 8,800 kg of methane per hour in August 2021 – the highest observed in Europe by GHGSat. GHGSat's observations were made just days after Madrid recorded its highest ever temperature during a heatwave that impacted much of Southern Europe. [11]

Methane emissions from landfills is a global issue. Europe must play its role as a global leader in GHG reduction and fighting climate change.

The benefits of landfill diversion offered by WtE become much more evident when adopting a time reference of 20 years, which better reflects the short-term climate impact of methane emissions and is in line with the latest scientific recommendations. [8]

Finally, further CO_2eq savings can be achieved in WtE plants through the **recovery of valuable raw materials, such as ferrous and non-ferrous metals from incineration bottom ash** (IBA), the residues from the combustion process. Metals and alloys such as steel, aluminium, copper and zinc are recycled from the bottom ash as secondary raw material at a lower environmental cost than the production of new metals. [14] [15] Besides metals, the mineral fraction of bottom ash can be recovered and used in road construction as a substitution for sand, cement, and aggregate production (bricks, paving tiles), along with other applications.

Incineration Bottom Ash recovery facility, Belgium. © Indaver, Tom D'haenens

2 STATUS QUO: The current climate balance of the European WtE sector

This section explores the current net carbon balance of the European WtE sector, as later depicted with a simplified representation in Figure 2.

The combustion of 1 tonne of residual waste in a conventional WtE facility generates approximately 1 tonne of total CO_2 emissions at the stack.
(TA – Section I. WtE direct CO_2 emissions)

However, CO_2 generated by WtE must be differentiated into two categories according to its origin:

- **fossil CO_2**, coming mainly from the combustion of fossil-based waste, such as residual plastics.
- **biogenic CO_2**, coming from the biogenic fraction of different waste streams, such as residual paper and cardboard, wood, leather, food, and green residues that are contaminated and thus not able to be recycled.

Although biowaste is more and more collected separately from households around Europe, and despite the many efforts geared towards achieving higher recycling rates, considerable amounts of biodegradable matter remain in the residual waste streams. Additionally, while separately collected biowaste is mostly treated in dedicated facilities like composting or anaerobic digestion plants, the residues that arise from these processes can be effectively treated at WtE facilities.

According to the IPCC guidelines [16], biogenic CO_2 is considered carbon neutral and it should not be accounted. Hence, as conventionally adopted in Life Cycle Assessment modelling [17], its climate burden is equal to zero. *(TA – Section I. WtE direct CO_2 emissions)*

The share of fossil and biogenic CO_2 depends on the composition of residual waste. On average, the share of biogenic CO_2 emissions monitored at the EU level by WtE plants is around **60%** (green bar in Figure 2)**, while the remaining 40% is fossil** (grey bar in Figure2). These values have been recorded by WtE plants operators across Europe (Sweden, Denmark, Germany, etc.) and also confirmed by a recent study promoted by the French Environment Agency (ADEME). [18]

The French "UIOM 14C" project and the "MassBio2" method, November 2020

In this study, 148 representative samples of more than 2 million tonnes of waste incinerated at 10 French WtE plants were collected through a monthly measurement campaign. A study of the biogenic and fossil content in the waste found that the average biogenic content of the CO_2 emissions emitted by the WtE plants was 58%. This corresponds to an **average biomass content of 67% of the total residual waste** treated and an **average share of renewables of 55% of the energy production done at WtE plants**. The project was developed by Cabinet Merlin and ENVEA and done in collaboration with ADEME and FNADE, which represents the private waste management industry in France.
(TA – Section I. WtE direct CO_2 emissions)

In the future, the amount of biogenic content in residual waste could potentially increase, the result of **higher source separation of plastics and the increase of bio-based products in the market** (paper for packaging, bioplastics, etc.). Together, these effects could lead to a higher concentration of biogenic CO_2 in the flue gas. This is another element to be considered when making future estimations, as the carbon impact of the European WtE sector could naturally decrease. At the status quo, the 60% biogenic CO_2 and 40% fossil CO_2 split leads to an **average emission factor for WtE of 400 kg CO_2eq per tonne of waste treated**. This emission factor is also in line with the values commonly adopted in scientific literature. [19]

The remaining amount of fossil CO_2 emitted is intrinsically linked to WtE's *Raison d'être*: thermally treating residual waste as a sanitary service to society. In particular, the main cause of the fossil emissions is related to the amount of plastic waste. A significant amount of the plastics put on the market are still non-recyclable.

This affects the composition of the WtE input, which is influenced by the entire value chain of virgin plastics production, consumption, and prevention. Plastic recycling activities also generate significant quantities of residues that cannot be transformed into new quality products but whose content can still be effectively recovered in terms of energy.

According to the European Environmental Agency's annual GHG inventories [20], historically, the total **fossil CO_2 emissions from WtE plants represents 1% of all GHG sources in Europe.** Despite an increase in the amount of waste treated at WtE plants, this number has essentially remained constant over the last decade, putting into perspective the WtE sector's actual carbon footprint. When discussing the direct impact of WtE from a climate perspective, a cost-benefit analysis should first consider the weight of this result when compared to the ca. 100 million tonnes of residual waste safely treated by WtE every year, while also keeping in mind that more than an equivalent amount is still landfilled across Europe or sent beyond its borders.

Additionally, when looking at the WtE sector's carbon impact, one must take into account not only the direct emissions, but also the indirect savings. The latter are represented with a minus sign in the bottom part of Figure 2.

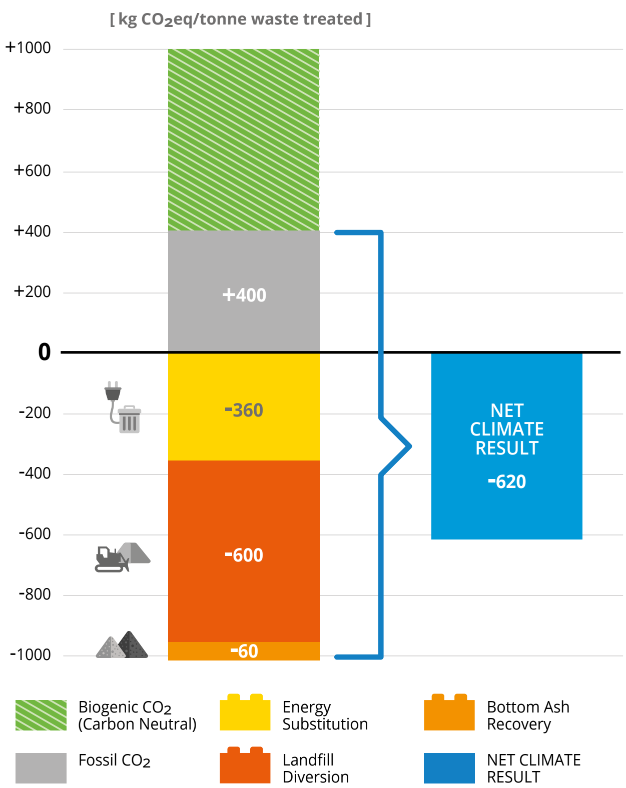

Figure 2: Current net carbon balance of the European WtE Sector, considering landfill diversion.

The first benefit can be found in the substitution of the fossil fuels that would be used for the equivalent production of electricity and heat (yellow bar). This considers the overall net electricity and heat efficiency of the European WtE sector combined with the current CO_2 emission factor of the European electricity and heat grid mix respectively. This leads to a **saving of 360 kg CO_2eq per tonne of waste** treated.
(*TA – Section II. Energy Substitution*)

Landfill diversion also provides a significant climate benefit: -600 kg CO_2eq per tonne of waste treated in a 100 year time perspective (red bar of Figure 2, *TA – Section III. Landfill Modelling*). Finally, the brown bar represents the **climate benefits through the recovery of ferrous and non-ferrous metals from bottom ash** (-60 kg CO_2eq per tonne of waste treated, *TA – Section IV. IBA Recovery*).

The sum of direct emissions (positive = burden) and avoided emissions (negative = savings) is an **overall negative balance: -620 kg CO_2eq per tonne of waste treated**. This means **WtE saves an average of 620 kg CO_2eq per tonne of waste treated.** If a 20-year period is considered to better reflect the short-term climate impact of methane emissions from landfills, the savings by WtE through landfill diversion is considerably higher (*TA – Section III. Landfill Modelling*).

"Waste to energy (WtE) strategies show the highest economic benefit with optimal GHG mitigation and energy potential. [...] Moreover, advanced WtE technologies are an emerging area in renewable energy production, which can create valuable opportunities for reducing greenhouse gas emissions."

International Energy Agency Greenhouse Gas R&D Programme (IEAGHG) Annual Review 2020

Control Room of the Kaunas cogeneration WtE plant, Lithuania. © Kauno kogeneracinė jėgainė

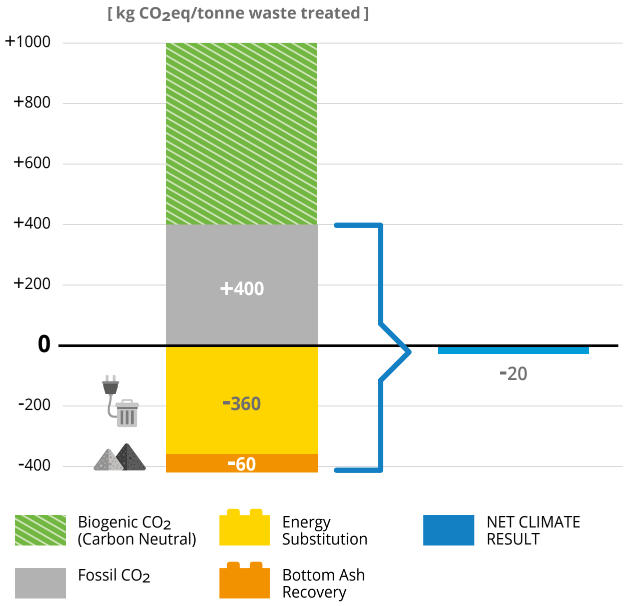

Figure 3: Current net carbon balance of the European WtE Sector, excluding landfill diversion.

Even when excluding landfill diversion and only taking into account energy substitution and bottom ash material recovery, WtE still completely offsets its direct fossil CO_2 emissions. The final carbon balance is now slightly negative (**-20 kg CO_2eq/ tonne waste treated**, meaning there are still some modest CO_2eq savings in place), so the overall balance can be considered carbon neutral. (Figure 3)

While offering a sanitary service to communities and contributing to the EU circular economy, the sector is already climate neutral today and plays an active role towards climate mitigation.

What more can be done? Carbon Capture Use & Storage: A vision for the WtE sector

3

The WtE sector brings many climate benefits and, overall, it already has a neutral carbon balance. But how can it further help Europe reach its target of net zero emissions by 2050?

The WtE sector is looking into Carbon Capture and Use or Storage (CCUS) as an extra but effective tool to further reduce its carbon footprint, with the possibility to reach net negative CO_2 emissions.

The concept of negative emissions is related to the fact that the climate burden of biogenic CO_2 is equal to zero, as this is part of the natural carbon cycle. Therefore, when a WtE facility captures both the fossil and the biogenic CO_2 from its processes, in effect, it is also removing CO_2 from the atmosphere.

CCU and Waste-to-Energy – the valorisation of CO_2 in the Netherlands

In Duiven, 120 km east of Rotterdam, CO_2 is captured at the AVR WtE plant and delivered by truck to the horticulture industry. Re-used CO_2 substitutes the use of natural gas in greenhouses for the cultivation of flowers, vegetables, and other plants. The CO_2 capture system was commissioned in August 2019, and has a capacity of catching 100,000 tonnes of CO_2 per year.

In Hengelo, at the Twence WtE plant, CO_2 is captured and transformed into sodium bicarbonate (baking powder), which is then reinjected into the plant's flue gas cleaning line. This is the first installation in the world to 'mineralise' CO_2 for circular re-use in residual waste treatment. Twence is also working with Aker Solutions to install a large scale CCU facility that will capture 100,000 tonnes of CO_2 annually on one line of the WtE plant. Twence announced their investment in November 2021.[21]

Both instances demonstrate how the valorisation of CO_2 not only saves raw materials, but also reduces the carbon footprint of the process.

CCS and Waste-to-Energy, the Norwegian case for permanent CO_2 storage

One example at an advanced stage is the CCS project at the Klemetsrud WtE plant in Oslo. Feasibility and concept studies were completed between 2015 and 2019. In March 2019, the successful pilot started testing using real flue gas. Starting in 2026, the full-scale plant will capture 400,000 tonnes of CO_2 per year (90% of its total CO_2 emissions). The negative emissions by the WtE plant will significantly help the city of Oslo achieve its decarbonisation objectives. CO_2 storage will be accomplished via ships and pipelines in the North Sea by Northern Lights, part of the wider Longship CCS project of the Norwegian Government.

The fossil and the biogenic carbon held within residual waste can be captured and permanently injected into deep geological storage (CCS). Alternatively, the captured CO_2 can be used (CCU) as a valuable resource in other industries or as a feedstock for new products like synthetic fuels, which are currently based on fossil imports such as oil and gas.

The last few years saw an array of different CCUS projects in the WtE industry kick-off across Europe.

> ***"The waste to energy (WtE) sector is another prime opportunity for negative emissions."***
>
> *The Global-Status of CCS 2021, Global CCS Institute*

The potential of and the opportunities for using CCUS technologies as a decarbonisation strategy in WtE facilities has been comprehensively explored in different regions of the world by a technical report [22] published by the International Energy Agency Greenhouse Gas R&D Programme (IEAGHG).

AVR WtE Plant (back) and CO_2 capture Unit (front), Duiven - The Netherlands. © AVR Afvalverwerking B.V.

"The integration of WtE and carbon capture and storage (CCS) could enable waste to be a net zero or even net negative emissions energy source. For example, in Europe only, the integration of CCS with WtE facilities has the potential to capture about 60 to 70 million tons of carbon dioxide annually."

UN IPCC Report, AR6 WGIII, Mitigation of Climate Change, April 2022

The role of the WtE sector in climate change mitigation was also acknowledged in April 2022 by the Intergovernmental Panel on Climate Change (IPCC) of the United Nations.

Amine-based chemical absorption is currently the main investigated capture technology in WtE facilities. This option, for partial and full CO_2 capture, has been considered for the projects in Norway and the Netherlands, as well as projects announced in Denmark, the UK and other countries in Europe.

FUTURE SCENARIO: Further climate savings from CCUS equipped WtE

The application of CCUS technologies in the WtE sector will vary on a case-by-case basis and according to the features of each plant. Some plants will be able to install and run a full-scale CO_2 capturing system. Others could opt for partial solutions based on, for example, their size, availability of a CO_2 transport network, storage and market opportunities for CO_2 usage. Figure 4 shows how the carbon balance of a tonne of waste treated at a WtE plant will improve with the partial integration of CCUS capturing 50% of the total CO_2. This would result in an **additional saving of 500 kg CO_2eq per tonne of waste treated** since both fossil and biogenic CO_2 will be captured at the stack. Therefore, **the existing climate benefits of Energy Substitution, Landfill Diversion and Bottom Ash Material Recovery by WtE, combined with the benefits of CCUS technologies, would reduce the net climate balance to -1040 kg CO_2eq per tonne of waste treated**.

Although it can be assumed that the benefits associated with Landfill Diversion and Bottom Ash Material Recovery will not change, it is important to note that the energy substitution will be reduced in the future and with the addition of CCUS. This is respectively because the grid energy mix substituted by WtE will be less carbon intensive, thanks to a higher penetration of renewables and because of the energy penalty of the CO_2 capturing process. On the other hand, the energy penalty caused by CCUS applications would be compensated for by introducing flue gas condensation, further recovering heat using heat pumps (*TA – Section V. Flue gas condensation*), and by higher energy performances expected in the European WtE sector in the future (*TA – Section II. Energy Substitution*).

Finally, Figure 5 shows how the WtE carbon balance would change if the contributions of landfill diversion were excluded.

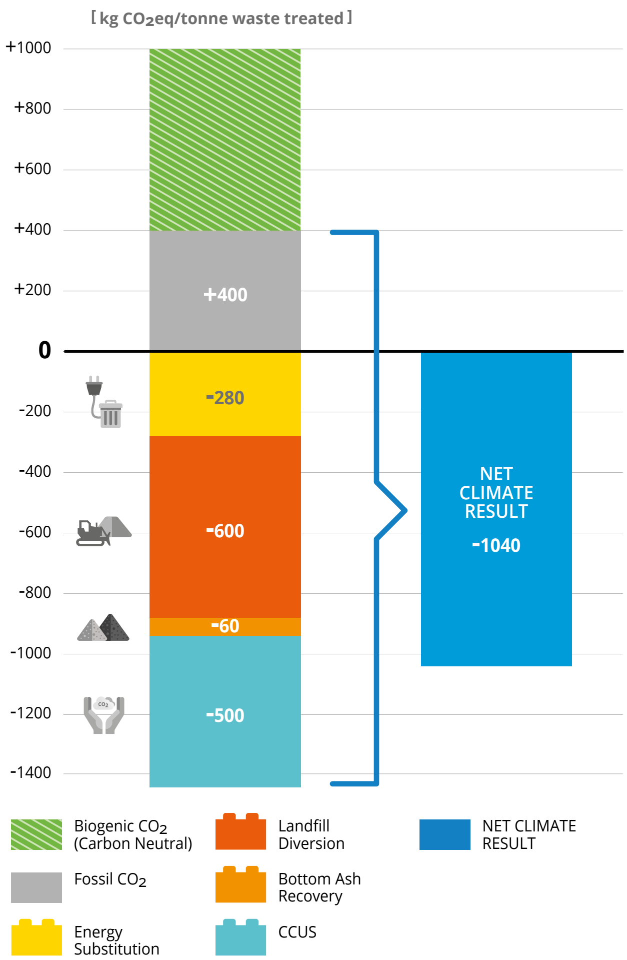

Figure 4: Future net carbon balance of the European WtE Sector with CCUS, considering landfill diversion.

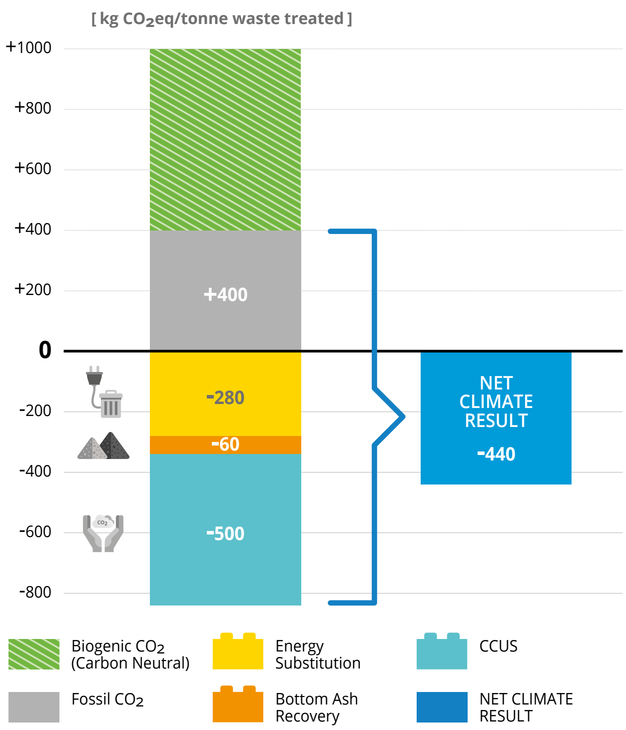

Figure 5: Future net carbon balance of the European WtE Sector with CCUS, excluding landfill diversion

Figure 5 clearly shows that, **in a future scenario, even when the important benefits of landfill diversion are excluded, the integration, even if partial (50% CO_2 capture rate), of CCUS technologies will still lead to a remarkable net negative carbon balance of -440 kg CO_2eq per tonne of waste treated in WtE plants**.

5 Annual reduction potential of WtE sector towards EU climate neutrality

Currently, there are ca. 500 WtE plants in Europe that treat ca. 100 million tonnes of residual waste per year. At the status quo, the net climate balance of the WtE sector corresponds to approximately -20 kg CO_2eq/t waste as illustrated previously in Figure 2. Thus, every year, **WtE saves approximately 2 million tonnes of CO_2eq**, even without taking into consideration the climate benefits associated with landfill diversion. **The overall balance for the WtE industry can therefore be considered carbon neutral already today.**

With the assumptions that in the future:

- the total amount of residual waste treated by WtE and its composition will remain constant (*TA – Section VI. Waste Generation*), and
- it will be possible to apply CCUS technologies equipped with flue gas condensation to at least 50% of the European WtE capacity, **capturing at least 50% of their total CO_2 emissions**

then, in terms of absolute values, the European WtE sector would be able to deliver net carbon savings of approximately **-20 million tonnes of CO_2eq every year**.

When the market and the infrastructure for CO_2 use and storage is fully deployed, it could also become feasible for WtE plants equipped with CCUS to capture almost all the CO_2 produced. Assuming a **90% capturing rate** applied to at least 50% of the European WtE capacity equipped with carbon capture and flue gas condensation, the savings reduction potential would be approximately **-40 million tonnes of CO_2eq every year**.

At a more ambitious projection, when CCUS technologies will have fully reached commercial maturity and the costs for their economies of scale have become marginal, a broader integration of carbon capture equipment in the entire European WtE sector can be foreseen.

Integrating 90% of the European WtE capacity with CCUS and **capturing 90% of the total CO_2 emissions**, the WtE sector could deliver, in a more ambitious and ideal scenario, a potential reduction of approximately **-75 million tonnes of CO_2eq every year.**

If landfill diversion was considered, the WtE climate savings contribution would be much larger in all scenarios.

The need for carbon removals has been expressed on several occasions by the EU institutions.[23] Negative emissions will be indispensable to reaching net zero. Thus, the technological progress and a wider commercial growth of CCUS will gradually increase the WtE sector's contribution towards a climate neutral EU.

> ***"The combustion of biogenic waste is accounted for as not adding to net CO_2 emissions. Combined with carbon capture and storage (CCS), the use of such waste to produce electricity or heat can indeed generate net carbon removals."***
>
> *Frans Timmermans, Vice-President of the European Commission [24]*

! This will only be possible with adequate political and financial support on the EU and national levels !

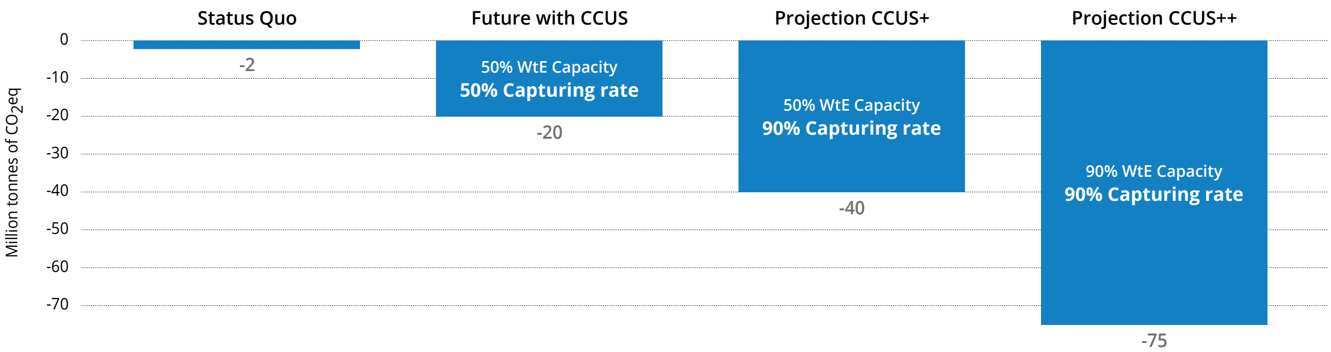

Figure 6: Annual reduction potential of European WtE sector, status quo and possible future projections based on different CCUS integration levels (million tonnes of CO_2eq)

Other synergies and industrial symbiosis

6

The possibility of capturing CO_2 from WtE opens the door to new opportunities for sector coupling with other industries.

Methanol, for example, is an essential raw material for the chemical industry. Until now, it has been produced using fossil fuels. However, methanol can be synthesised with the combination of CO_2 and hydrogen, both of which can be sustainably produced by WtE. This is the goal of the Power-to-Methanol trial facility of a consortium with Indaver that will be built in the Port of Antwerp.

Captured CO_2 from a WtE plant and sustainable hydrogen can also be used as building blocks for chemicals or materials, such as CO_2-based plastics. This is the goal of the Waste-to-Material value chain under development with the Carbon2x pilot in Riihimäki, Finland.

"Another promising route is to turn CO2 from a waste to a resource and use it as feedstock for the production of chemicals, plastics, or fuels."

Sustainable Carbon Cycles, European Commission [23]

In addition to its combination with CO_2 to produce synthetic products and fuels, hydrogen will play a major role in the European Green Deal, especially as to the decarbonisation of the transport sector. Unlike other renewable energy sources, a big advantage of WtE is the possibility to rely on the programmability and flexibility of energy generation that can be used, in part, for producing hydrogen via water electrolysis. Some European WtE plants have already started to contribute to this possibility, as the Wuppertal WtE plant in Germany.

In this way, WtE plants circulate energy through innovative solutions that help decarbonise some "hard-to-abate" sectors such as road transport.

Cleaner urban mobility at the Waste-to-Wheels project in Wuppertal, Germany

A Polymer Electrolyte Membrane electrolyser with the capacity of 1 MW uses electricity generated by Wuppertal's WtE plant to produce green hydrogen (H2). This can feed 20 fuel cell-powered buses that contribute to diesel-free public transportation while also improving air quality in the city. The H2 filling station is located next to the plant and the H2 fleet will soon be extended to waste collection trucks.

Indaver integrated facilities, Belgium. © Indaver, Tom D'haenens

7 WtE can't do it alone – the need for a common effort

WtE is not an island. It is fundamental that the entire waste and product value chain takes part in the effort to reduce fossil residual waste.

CEWEP strongly supports the prevention and, if this is not possible, efficient source separation of waste to enable quality recycling. If plastic waste, which is the main source of WtE's fossil emissions, is more efficiently separated at the source, this will enable quality recycling and significantly reduce WtE plants' CO_2 emissions. Only waste that cannot be used for quality recycling should go into WtE plants, which accepts it as a service to society. This service ensures the reliable treatment of residues from sorting and recycling facilities, avoiding landfilling of recoverable waste and the pollution of recycling circles. WtE plants are regulated and controlled through the most stringent EU legislation and have invested in continuously improving their environmental performance, contributing to several EU objectives (e.g., industrial emissions reduction, air quality, water and soil quality).

Consumer behaviour and producer responsibility

Non-recycled plastic waste is a source of fossil emissions. Producers and consumers need to take responsibility for its environmental cost. WtE operators do not have a choice on the characteristics of the waste input when it comes to a WtE facility and therefore have little leeway to reduce the carbon footprint of the WtE plant upfront. The non-recyclable plastic waste that is not sent to WtE plants would otherwise be landfilled, exported to other countries (who often have lower environmental and social standards than European countries), or treated in industrial plants that don't have to fulfil the same environmental requirements. The composition of the input – and therefore the amount of plastics in it – is influenced more by the entire value chain of virgin plastics (eco-design, manufacturing) and quality of source or by any further separation than by WtE plants.

Consumer behaviour and producer responsibility upfront need to be changed because everything will eventually become waste.

Plastic waste at a landfill site in Borneo, Malaysia. © IStock by Getty Images

Call to policy makers: What is needed by the WtE sector to make this happen?

The WtE industry is already at work and is ready to make all necessary contributions to help Europe reach its 2030 and 2050 climate targets. However, some enabling conditions are necessary:

Apply waste hierarchy and Life Cycle Assessment

Residual waste must be minimised along the raw material's entire life cycle. Once produced, it must be managed in an environmentally sound way that takes into consideration its entire life cycle. While the waste hierarchy is the natural driver for decision-making, the impact on the environment must also be taken into account, as stated in the EU Waste Framework Directive, while keeping costs under control. The waste hierarchy gives prevention and recycling clear priority against energy recovery. However, it also gives energy recovery priority over disposal operations (e.g., landfilling).

Minimise methane emissions from landfills

The WtE sector calls on the EU to recognise methane's global warming effect by prioritising measures to minimise methane emissions from landfilling.

Restricting landfills to waste not suitable for material and energy recovery

The climate benefits of diverting waste from landfills to higher steps in the waste hierarchy such as recycling and energy recovery are also explored by the study conducted by Prognos and CE Delft on the CO_2eq savings potential by the European waste sector. This study concludes that significant contributions to the climate objectives can be achieved by the European waste management industry by successfully implementing current EU municipal waste legislation and applying the same recycling and landfill targets to industrial and commercial waste.[25]

Common perception and recognition

An in-depth dialogue is needed to avoid any misunderstanding regarding the commitment of WtE operators to be a service to the community and to treat the residuals of societal activity with the lowest possible environmental and climate impact. Efforts that existing installations are putting in place to further increase their contributions to EU objectives and societies should be supported.

A market mechanism and certification system for negative emissions

A policy framework that gives legal security for investment is needed to stimulate a broader technological development of CCUS, which still suffers from economies of scale.

CO_2 transport infrastructure

Capturing CO_2 won't be enough. Thus, a common European network should be established to collect and deliver CO_2 produced from different industrial clusters at the regional level.

CO_2 use

Not all European countries will have easy access to CO_2 permanent storage sites. Incentives are needed for innovative projects on CO_2 valorisation and the final creation of a CO_2 market.

Public and private investments

Waste is a public issue. CCUS is an innovative tool to further reduce the carbon footprint of WtE plants. Until this becomes commercially viable, the WtE sector, local, national and European authorities, along with its citizens, need to work together to finance this necessary technological development that will secure climate friendly treatment of the residual waste produced by society and industry.

Higher technology readiness level

Promote research and experimental investigation on CCUS.

> ***"Thermal waste treatment enables a climate neutral, reliably available base load electricity and heat generation while serving its key task, which is waste treatment."***
>
> *Wuppertal Institut, Germany [26]*

9 Conclusions

Can we live without WtE?

There are around 500 WtE plants operating across Europe, treating an estimated 100 million tonnes of residual waste annually. The WtE sector has, apart from its hygienic task, a pivotal role to play in moving towards a resource-efficient, low-carbon, circular economy.

WtE is an established, secure, and sustainable energy provider for both electricity and heat that uses residual materials that cannot be further recycled.

In many European countries landfills are still the big elephant in the room. Diverting waste that can be recycled or recovered from landfills has numerous benefits, including the reduction of disperse methane emissions and a rapid aid to fight climate change.

From carbon neutral to carbon negative

Evaluations should be assessed in a comparative and holistic way, looking at possible alternatives for the safe treatment of residual waste. Even without considering the important benefits associated with landfill diversion, the European WtE sector offsets its fossil CO_2 emissions. As a result, at present, it can be considered carbon neutral.

In the future, WtE has the potential to further reduce its carbon footprint through the application of CCUS technologies, if supported by policy. This is an extra but effective tool for reaching net negative CO_2 emissions.

When tradition meets innovation

The WtE sector is studying the best solutions for integrating CCUS technologies on a case-by-case basis while guaranteeing the full compliance of high environmental standards. If supported by EU policies, WtE will be a pivotal enabler of carbon neutrality by 2050. It will also continue contributing to the circular economy and sustainable waste management within the European Green Deal.

Budapest WtE plant, Hungary. © László Horváth, Budapest Utilities Nonprofit Zrt

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The voice of Waste-to-Energy

CEWEP (Confederation of European Waste-to-Energy Plants) is the umbrella association of the operators and owners of Waste-to-Energy plants, representing about 400 plants from 23 countries. They make up more than 80% of the Waste-to-Energy capacity in Europe.

Our members are committed to ensuring high environmental standards, achieving low emissions and maintaining state of the art energy production from remaining waste that cannot be recycled in a sustainable way.

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