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# Waste-to-Energy with Carbon Capture

*An untapped potential for Türkiye to deliver energy, circularity and decarbonisation*

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## Disclaimer

This paper is intended to inform public discussion. It is not a detailed technical study and does not constitute investment, legal or engineering advice. While the authors consider the data and analysis presented to be sound, readers should rely on their own judgement when using them. Estimates for Türkiye are illustrative and are based on the assumptions stated in the text. The views expressed are those of the authors and do not necessarily reflect those of their organisations.


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# Abbreviations

| | |
|---|---|
| **BECCS** | Bioenergy with carbon capture and storage |
| **CCfD** | Carbon contract for difference |
| **CCS** | Carbon capture and storage |
| **CDR** | Carbon dioxide removal |
| **CEWEP** | Confederation of European Waste-to-Energy Plants |
| **CHP** | Combined heat and power |
| **EBRD** | European Bank for Reconstruction and Development |
| **EOR** | Enhanced oil recovery |
| **ETS** | Emissions trading system |
| **GHG** | Greenhouse gas |
| **IFC** | International Finance Corporation |
| **İSTAÇ** | Istanbul Environmental Management Industry and Trade Inc. |
| **MIGA** | Multilateral Investment Guarantee Agency |
| **Mt / Gt** | Million tonnes / billion tonnes |
| **MoEUCC** | Ministry of Environment, Urbanisation and Climate Change (Türkiye) |
| **OeEB** | Oesterreichische Entwicklungsbank (Development Bank of Austria) |
| **PPP** | Public–private partnership |
| **TPAO** | Turkish Petroleum Corporation |
| **TÜİK** | Turkish Statistical Institute |
| **WtE** | Waste-to-energy |
| **YEKDEM** | Renewable Energy Resources Support Mechanism (Türkiye) |

# Executive summary

Waste-to-energy (WtE) offers a distinctive solution for emerging economies such as Türkiye, which face a trilemma of climate, energy and environmental challenges. **WtE can simultaneously support Türkiye's Zero Waste strategy through increased material recovery, strengthen energy security through domestic production, and deliver emissions reductions or even durable carbon removals.** Realising these benefits requires coordinated waste and energy planning, robust carbon accounting and viable financing frameworks.

In 2024, 71% of all waste collected in Türkiye was sent to controlled landfills. The Zero Waste programme and national waste-management targets provide a framework for improvement. **WtE can complement waste prevention and recycling by treating residual, non-recyclable waste.** Regional capacity planning should reflect changing residual-waste quantities and composition as prevention and recycling improve. WtE can recover domestic electricity and useful heat, with Türkiye's sole plant, in Istanbul, providing implementation experience. **Industrial heat supply and suitable district heating networks could improve energy recovery** where demand, infrastructure and offtake arrangements are co-located.

**The only technically viable solution for decarbonising WtE is carbon capture and storage (CCS).** Approximately half of WtE emissions are of biogenic origin and are counted as zero, but the remaining fossil emissions must also be mitigated to reach net zero. CCS reduces fossil $CO_2$ emissions by up to 90% and can deliver durable carbon removals through the permanent storage of biogenic $CO_2$. As an illustrative example, if half of the 32.3 million tonnes of municipal waste collected in Türkiye were treated through WtE with CCS, **some 6.3 million tonnes of durable removals could be achieved, equivalent to 1.2% of Türkiye's total 2024 emissions**.

**Securing finance for WtE expansion depends on bankable waste-treatment revenues, electricity and heat contracts, enabling infrastructure and clear risk allocation.** Savings under compliance carbon markets (such as the Turkish ETS) or revenues from voluntary carbon markets may provide additional support where eligibility and certification requirements are met.

**Recommendations for the responsible expansion of WtE in Türkiye**

**Government:** Translate waste-management targets into regional implementation plans, assess residual-treatment capacity needs and discourage landfilling. Require all new WtE plants to be CCS-ready and to meet minimum efficiency standards. Establish clear criteria for recognising WtE-related reductions and removals within carbon-crediting and ETS frameworks. Advance $CO_2$ storage appraisal, CCS regulation and carbon capture subsidies. Coordinate the formation of CCS hubs in industrial zones.

**Municipalities:** Integrate waste-treatment, land-use and heat planning; develop targets and strategies to reduce the volume of waste sent to landfill; build internal capabilities; and support public participation through transparent environmental reporting.

**Financial institutions:** Assess projects against credible waste and energy-demand scenarios, support viable heat and $CO_2$ infrastructure, and develop financing structures that can address the remaining uncertainties in CCS value chains.

CHAPTER 1

# WtE for Zero Waste

## 1.1 Türkiye's residual waste challenge

Türkiye generates a large and growing volume of municipal waste. In 2024, municipalities collected 32.3 million tonnes (Mt) of waste, equivalent to 1.09 kg per person per day.[1] Most of this was landfilled or recovered, but 10.9% still ended up at municipal dumpsites. Across all waste categories, 194 Mt of waste were collected and treated as follows: 71% in controlled landfills, 26.5% through composting and material recovery, and 2.4% through co-incineration at industrial sites. The share of dedicated incineration, also known as waste-to-energy (WtE), was only 0.2%.[1]

The national Zero Waste (Sıfır Atık) programme, launched in 2017, has driven real progress. The Ministry of Environment, Urbanisation and Climate Change (MoEUCC) reports[2] that the municipal waste recovery rate rose from 13% in 2017 to 37.5% in 2025, with targets of 60% by 2035 and 70% by 2053. The new National Waste Management Strategy and Action Plan (2025–2035)[3] aims to end the use of uncontrolled dumpsites by the end of 2028. Achieving these targets requires continued investment in waste prevention, separate collection and recycling. WtE is the next-best option for the treatment of residual (non-recyclable) waste.

Waste is also a climate issue. The waste sector accounted for only 2.6% of Türkiye's greenhouse gas emissions in 2024, but for 18.5% of its methane emissions.[4] Methane is around 80 times more potent than $CO_2$ over a 20-year time horizon, and waste accounts for around a fifth of human-caused methane globally.[5] Reducing landfill methane is therefore one of the fastest ways to slow near-term warming.

## 1.2 Where WtE sits in the waste hierarchy

The waste hierarchy, enshrined in European law since 2008, ranks waste-management options from prevention, through re-use and recycling, to other recovery and, finally, disposal (Figure 1).[6] WtE – incineration with efficient energy recovery – is a form of 'other recovery'. It is not a substitute for prevention or recycling and should be sized for the residual waste that remains after the measures higher up the hierarchy. However, WtE is clearly preferable to disposal. This is why the EU requires[7] member states to reduce the share of municipal waste sent to landfill to 10% or less by 2035.

1. Turkish Statistical Institute (TÜİK), Waste Statistics, 2024 – Bulletin No. 54134 (November 2025). [Link]
2. Republic of Türkiye Ministry of Environment, Urbanisation and Climate Change, Sıfır Atık'ta Geri Kazanım Oranı %37,53'e Ulaştı (2026). [Link]
3. Republic of Türkiye Ministry of Environment, Urbanisation and Climate Change, 2025–2035 National Waste Management Strategy and Action Plan – Ministerial announcement (October 2025). [Link]
4. TÜİK, Greenhouse Gas Emission Statistics, 1990–2024 – Bulletin No. 58000 (March 2026). [Link]
5. UNEP and Climate and Clean Air Coalition, Global Methane Assessment: Benefits and Costs of Mitigating Methane Emissions (May 2021). [Link]
6. European Union, Directive 2008/98/EC on waste (Waste Framework Directive) (November 2008). [Link]
7. European Union, Directive (EU) 2018/850 amending Directive 1999/31/EC on the landfill of waste (May 2018). [Link]

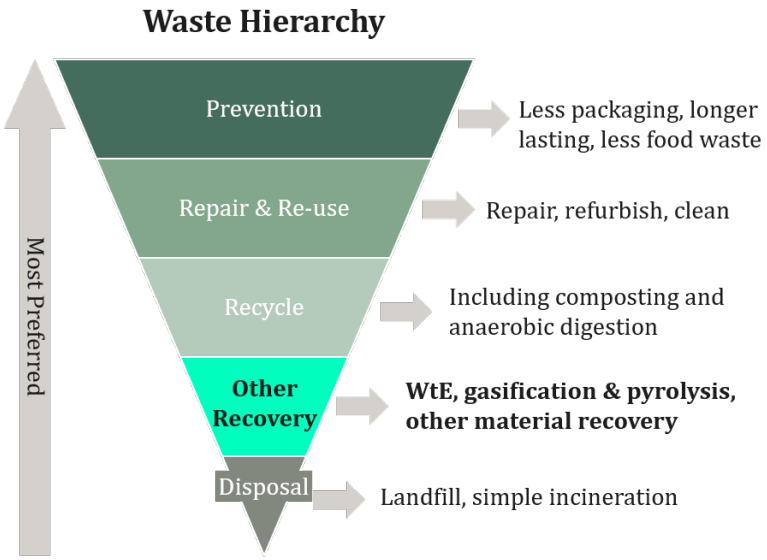



**Figure 1:** The waste hierarchy and the position of WtE[6]

## 1.3 Why WtE is preferable to landfill

Biogenic wastes disposed of in conventional landfills decompose over decades and emit methane. Landfills with methane recovery are a clear improvement on regular landfills and open dumps, but they only partially reduce methane emissions and recover far less energy than WtE. WtE converts the carbon in waste to $CO_2$ immediately and under controlled conditions, reduces the volume of waste by up to 90%,[8] requires a smaller land footprint and also recovers some materials. The European WtE association, CEWEP, estimates that diverting residual waste from landfill to WtE avoids around 600 kg of $CO_2$eq per tonne of waste.[9] The exact benefits of WtE over landfills with methane recovery depend on local circumstances, but are expected to increase with stricter environmental regulation and climate targets.

Replacing dumpsites and ageing landfills with WtE reduces the risks of fires, odour, vermin and leachate contaminating soil and groundwater. Modern plants must meet strict emission limits: multi-stage flue gas treatment removes nitrogen oxides, acid gases, dioxins and fine particles. Because a plant treating a million tonnes a year occupies only a few hectares, WtE also frees up land near growing cities, and well-designed plants – such as CopenHill in Copenhagen (Box 1) – can become valued civic landmarks rather than unwanted neighbours.

WtE is also a materials recovery process. Bottom ash – around a fifth of the waste input by weight[10] – contains ferrous and non-ferrous metals, which are recovered using magnets and eddy-current separators; the remaining mineral fraction can be used as secondary aggregate, for example in road construction. In the UK, 99% of the 3.3 million tonnes of bottom ash produced in 2025 was sent for recovery.[10]

8. Soni, A., Gupta, S.K., Rajamohan, N. and Yusuf, M., Waste-to-energy technologies: a sustainable pathway for resource recovery and materials management, Materials Advances 6(14), 4598–4622 (2025). [Link]
9. CEWEP, Waste-to-Energy Climate Roadmap: The Path to Carbon Negative (June 2022). [Link]
10. Refynix, UK Energy from Waste Statistics 2025 (May 2026). [Link]

**Table 1:** Comparison of WtE and landfill

| | WtE (incineration) | Landfill | Landfill with methane recovery |
|---|---|---|---|
| **Land use** | Low | High | High |
| **Greenhouse gases** | $CO_2$, around half of it biogenic | Methane | Some methane leakage plus $CO_2$ |
| **Energy recovery** | Electricity and heat | None | Limited |
| **Material recovery** | Metals and bottom ash | None | None |
| **Contamination risk** | Low, with controlled residues | Leachate and contamination risk | Leachate and contamination risk |
| **Upfront cost** | High | Low | Moderate |

CHAPTER 2

# How WtE works

At its core, a WtE plant is a thermal power station that uses residual waste as its fuel. Waste is delivered to an enclosed bunker kept under negative pressure to contain dust and odours, mixed to even out its composition, and fed onto a moving grate, where it burns at temperatures above 850 °C.[11] The hot flue gases pass through a boiler that raises steam to drive a turbine and generator; steam can also be extracted to supply heat to district heating networks or industrial processes. The flue gases are then cleaned before release through the stack (Figure 2). Incineration reduces the mass of waste by 70–80% and its volume by 80–90%.[8] For every tonne of waste treated, plants produce 588 kWh of electricity, approximately 200 kg of bottom ash and approximately 30 kg of air pollution control residues.[10]

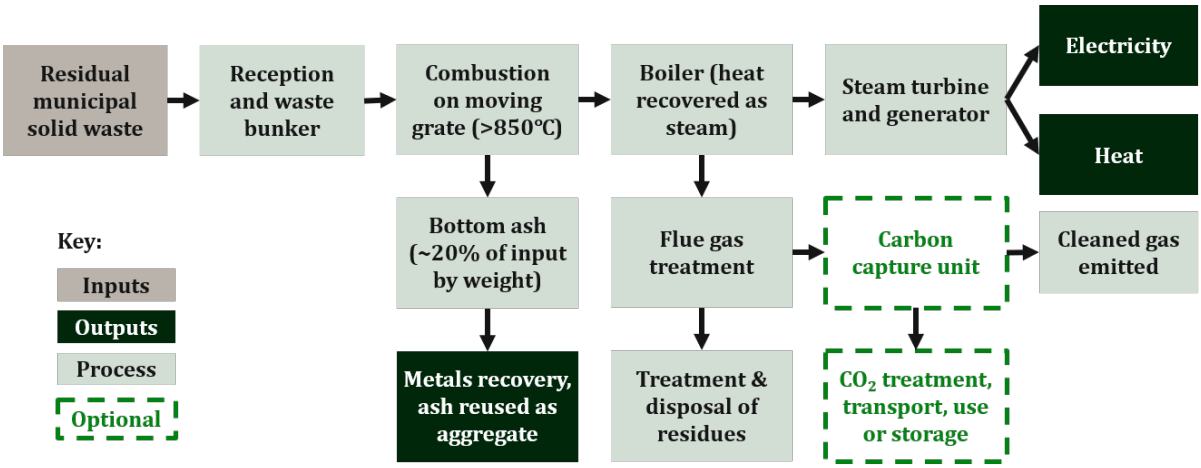



**Figure 2:** Simplified WtE process flow diagram

WtE is not a novel technology. In the UK, waste incineration began in the late nineteenth century.[12] Over time, the focus shifted from pure incineration to energy recovery at increasing levels of efficiency. Today, 64 UK plants are fully operational; they processed 17.1 Mt of waste in 2025, and around half of the local authority waste collected in England is sent to WtE.[10,13] Across Europe, around 500 WtE plants treat roughly 100 Mt of residual waste every year,[14] generating enough electricity for 20 million people and heat for around 17 million.[9] China has made the fastest transition of all: incineration overtook landfill as the main treatment route for household waste in 2020, and by 2023 its share had reached 78%.[15] With global waste projected to rise from 2.01 billion tonnes in 2016 to 3.40 billion tonnes by 2050, the need for proven and efficient treatment capacity will only grow.[16]

11. Deltaway Energy, Waste-to-Energy: How It Works (August 2018). [Link]
12. Busy Bins, The History of Waste Management (January 2025). [Link]
13. UK Department for Environment, Food & Rural Affairs, Local authority collected waste management – annual results 2024/25 (March 2026). [Link]
14. CEWEP, Waste-to-Energy in Europe in 2022 (February 2025). [Link]
15. Sixth Tone / The Paper, Do China's Waste Incinerators Have Enough to Burn? (July 2025). [Link]
16. Kaza, S., Yao, L., Bhada-Tata, P. and Van Woerden, F., What a Waste 2.0: A Global Snapshot of Solid Waste Management to

### Box 1: CopenHill – a new city landmark

CopenHill (Amager Bakke) is a combined heat and power WtE plant in central Copenhagen, operated by ARC, a company owned by local municipalities.[17] It began producing energy in 2017, replacing an older incinerator on the same site.[18] It cost around US$670 million,[19] financed through Denmark's municipal lending model.

The plant is highly efficient. In 2022 it covered the electricity needs of around 90,000 households and the heating needs of around 80,000 apartments, recovering around 2.7 MWh of district heat and 0.8 MWh of electricity from each tonne of waste.[18] CopenHill hosted two pilot carbon capture projects between 2021 and 2025 and has ambitions to scale up the technology for deep decarbonisation.[20]



**Figure 3:** Amager Bakke WtE plant[18]

What makes CopenHill world-famous is its roof, which hosts a year-round artificial ski slope, a hiking trail and a rooftop café, alongside an 80-metre climbing wall on its façade. The plant has no noise or odour impact on its surroundings. By turning essential infrastructure into a city landmark, the project demonstrates how good design can transform the public's relationship with waste and environmental services.

2050, World Bank (September 2018). [Link]

17. Ramboll, State-of-the-art waste-to-energy facility in Copenhagen (accessed October 2026). [Link]
18. ARC – Amager Ressourcecenter, Om Amager Bakke (accessed October 2026). [Link]
19. Rathi, A., You can now ski on top of a $670 million power plant in Copenhagen, Quartz (February 2019). [Link]
20. ARC, Demonstration unit for carbon capture (accessed November 2026). [Link]

CHAPTER 3

# Domestic low-carbon energy from waste

## 3.1 How much energy can WtE produce?

The energy that WtE recovers depends on how a plant is designed and whether its heat can be used. In 2025, UK plants predominantly generated electricity, at a rate of 588 kWh per tonne of waste.[10] Combined heat and power plants connected to district heating, such as CopenHill, recover around 3.5 MWh of useful energy per tonne.[18] As an illustration, if half of the 32.3 Mt of municipal waste collected in Türkiye were sent to WtE with similar electricity yields, 9.5 TWh of power could be generated annually, equivalent to 2.6% of Türkiye's 2025 electricity production.[21]

## 3.2 A baseload domestic resource for energy security

Türkiye relies on imports for around 72% of its energy needs,[22] while renewables supplied 43% of its electricity in 2025. The National Energy Plan[23] aims to increase this share to 55% by 2035. As the share of variable wind and solar power grows, firm and dispatchable generation becomes more valuable. WtE plants run at baseload (with average availability above 80%[10]), complementing intermittent generation. Their fuel is local and paid for through gate fees, insulating them from fossil fuel price shocks and increasing national energy security.

Depending on user demand, electricity can also be supplied through private wire connections. As a recent ERM study has demonstrated,[24] connections to strategic assets such as data centres can avoid long grid-upgrade timelines and directly decarbonise the power used.

## 3.3 Electricity or heat? Lessons from Europe

How WtE energy is used varies strongly between countries (Figure 4). Nordic countries with extensive district heating networks recover 2–3 MWh per tonne, mostly as heat, while the UK, Spain and Portugal, which lack such networks, export mainly electricity and recover less than 1 MWh per tonne.[25] More than 60% of European WtE plants operate as combined heat and power plants.[9]

## 3.4 Designing for heat in Türkiye

Future Turkish WtE plants should assess heat integration from the outset, based on local demand, seasonal consumption, delivery distances and network costs:

- **District heating for new developments:** locating plants near large developments, including

21. Republic of Türkiye Ministry of Energy and Natural Resources, Elektrik Üretim ve Tüketiminde Rekor (January 2026). [Link]
22. World Bank, World Development Indicators – Energy imports, Türkiye (accessed October 2026). [Link]
23. Republic of Türkiye – Ministry of Energy and Natural Resources, Türkiye National Energy Plan (2022). [Link]
24. RRUK, EfW-Industrial Power Connections (accessed November 2026). [Link]
25. Tolvik, UK Energy from Waste Statistics – 2024 (April 2025). [Link]

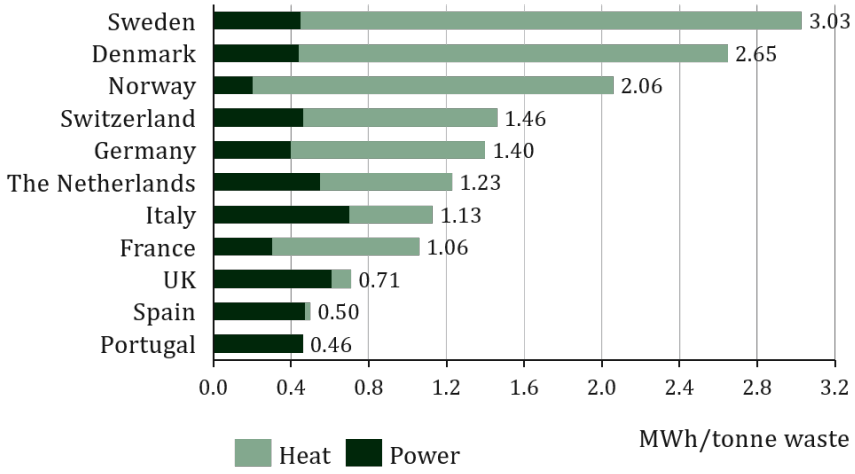



**Figure 4:** Type of energy exported from WtE plants[25]

urban regeneration and reconstruction areas, can allow heat networks to be built in from the start.

- **Industrial heat:** co-locating WtE with industrial users can create opportunities to supply steam or heat and reduce natural gas demand where temperature requirements and operating schedules are compatible.
- **Low-grade heat uses:** surplus low-temperature heat can serve greenhouses and industrial processes and, in future, technologies such as carbon capture and direct air capture.

CHAPTER 4

# Unlocking carbon removals via CCS

## 4.1 Why is WtE not zero-emission?

Municipal waste is a mixture of biogenic materials, such as food, garden waste, paper, wood and natural textiles, and fossil-based materials, mainly plastics and synthetic textiles. The share of biogenic carbon in waste is highly location-dependent but usually lies in the 50–60% range.[9,10] Under corporate GHG accounting rules, biogenic $CO_2$ emissions are counted as zero, since they represent the return of photosynthesised carbon to the atmosphere. However, the carbon intensity of electricity from WtE is still around 693 $gCO_2$/kWh owing to its fossil carbon content, placing it between coal- and natural gas-fired electricity[10,26,27] (Figure 5). These emissions may be justified on the grounds that the primary role of WtE is waste management, with electricity a by-product. However, reaching net zero will eventually require the mitigation of all WtE emissions.

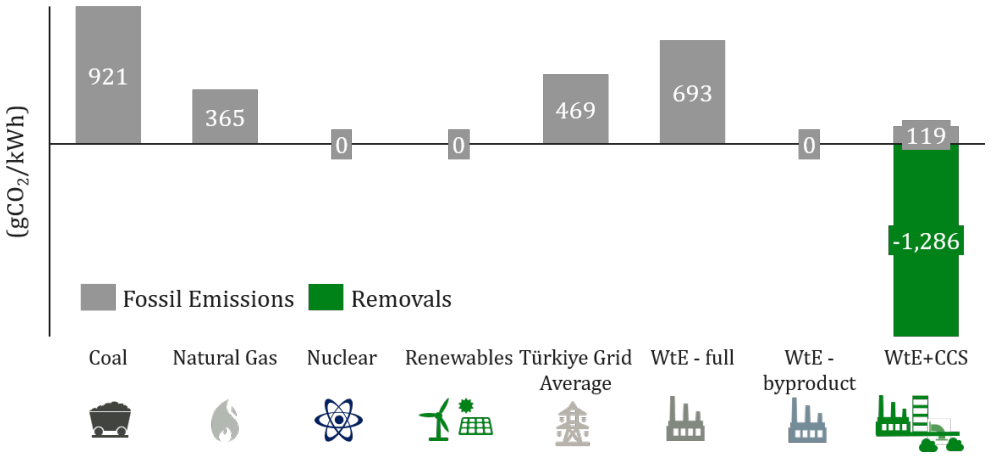



**Figure 5:** Carbon intensity of electricity[10,26,27]

## 4.2 Carbon capture: the only route to deep decarbonisation

Reducing fossil-based materials in residual waste can lower WtE emissions, but carbon capture and storage (CCS) is the only feasible option for eliminating most of the remaining fossil $CO_2$. The process involves chemical reactions (most widely using amine solvents) that capture up to 95% of the $CO_2$ in the flue gas; treatment of the $CO_2$; transport by pipeline, ship or truck; and injection into underground geological formations. $CO_2$ stored in saline aquifers or depleted oil and gas fields can be safely locked away for more than 1,000 years.

Capturing and permanently storing fossil $CO_2$ reduces emissions that would otherwise en-

26. UK DESNZ, Digest of UK Energy Statistics (DUKES): electricity (July 2026). [Link]
27. Ministry of Energy and Natural Resources, Türkiye Elektrik Üretimi ve Elektrik Tüketim Noktası Emisyon Faktörleri (December 2025). [Link]

ter the atmosphere. Capturing and permanently storing biogenic $CO_2$ can deliver carbon dioxide removal (CDR, also known as negative emissions), because the carbon was previously absorbed from the atmosphere. ERM estimates that sending all of an average UK resident's waste to WtE with CCS could cut their personal carbon footprint by up to 6.4%.

## 4.3 Negative emissions and the need for removals

Every credible net-zero pathway relies on removals to balance residual emissions. Today, novel CDR methods – such as direct air capture or biochar – remove only around 2 $MtCO_2$ a year, compared with around 2.2 $GtCO_2$ from conventional forest-based CDR. National pledges fall well short of the 5 Gt of CDR a year needed by 2050 in 1.5 °C climate pathways.[28] Bioenergy with CCS (BECCS) – of which WtE with CCS is a form – and biochar account for almost all novel removals today. WtE plants are prime candidates for BECCS because their feedstock is a sustainable source of biomass (provided waste has been adequately recycled beforehand) and their scale is generally large enough to justify CCS integration.

Europe is leading the deployment of WtE with CCS. In Oslo, Hafslund Celsio is building capture capacity of 0.35 $MtCO_2$ a year at its Klemetsrud plant, with storage under the North Sea from 2029.[29] In the UK, the Protos WtE plant reached financial close in September 2025 and will capture around 0.37 $MtCO_2$ a year.[30] ERM's analysis for the UK shows that CCS on all UK WtE plants could capture around 20 $MtCO_2$ a year, more than 10 Mt of which would be removals, unlocking £19.0 billion of investment, £38.8 billion of gross value added and 9,350 permanent jobs.[31]

For Türkiye, an illustrative scenario in which half of the 32.3 Mt of municipal waste collected annually is treated through WtE with CCS would yield approximately 6.3 Mt of net CDR, assuming a capture rate of 90%, a biogenic carbon fraction of 54% and lifecycle emissions of 20%. This represents approximately 1.2% of Türkiye's 2024 emissions.[4] If Türkiye were to commit to a 5–10% CDR sub-target on its path to net zero, WtE with CCS could provide a sizeable portion of it.

## 4.4 Potential revenue opportunities from carbon markets

WtE projects could, in principle, access carbon revenues through three activities: avoided landfill emissions from the base WtE plant, and fossil $CO_2$ reductions and permanent CDR achieved through the installation of CCS (Table 2). These three activities have very different characteristics, eligibility requirements and perceived value to buyers, all of which may change as the policy and economic landscape evolves.

Buyers are already signing contracts: Microsoft has agreed to buy 1.1 Mt of removals over ten years from Hafslund Celsio[29] and 2.95 Mt from Gaia in Denmark.[32] Forecasts suggest that the market for durable removals could be worth US$20–135 billion a year by 2040.[33]

Türkiye's Climate Law (No. 7552) establishes the legal basis for a national carbon crediting

28. Edwards, M., et al., The State of Carbon Dioxide Removal, 3rd Edition (June 2026). [Link]
29. Hafslund Celsio, Hafslund Celsio announces a 10-year carbon removal agreement with Microsoft (June 2025). [Link]
30. UK DESNZ, Pioneering carbon capture projects ready for construction (September 2025). [Link]
31. ERM, EfW with CCS: a key pillar for net zero in the UK (November 2024). [Link]
32. Gaia, CIP and Vestforbrænding's joint venture, Gaia, signs long-term offtake agreement for carbon removal with Microsoft (July 2025). [Link]
33. GFI and ERM, The Role of Carbon Markets in Financing Carbon Dioxide Removals (July 2025). [Link]

**Table 2:** Three types of carbon credit from WtE

| | Base WtE plant | Capture of fossil $CO_2$ | Capture of biogenic $CO_2$ |
|---|---|---|---|
| **Climate action** | Avoids landfill methane emissions | Reduces fossil emissions compared with no CCS | Permanently stores biogenic carbon |
| **Category** | Emissions avoidance | Emissions reduction | Carbon removal |
| **Indicative credit price** | Low | No precedent; likely low | Currently US$200–350 per tonne, but demand may be limited |
| **Additionality** | Requires case-by-case proof based on alternative treatment options | Very high if outside an ETS | Very high |
| **Quantification** | Relies on estimated landfill emissions in the business-as-usual case | Directly measured, adjusted for lifecycle emissions | Directly measured, adjusted for lifecycle emissions |
| **Co-benefits** | Community health, soil and water protection | Low | Low |
| **Examples** | Mainly China (e.g. Huangshi, Chiping, Jiangmen) | None yet | Mainly Europe (e.g. Protos, Hafslund Celsio, Gaia) |

and offsetting system covering emission reductions and removals.[34] It allows permitted types of nationally generated credits to be used to meet part of the obligations under the new Turkish Emissions Trading System (ETS). If regulators develop crediting methodologies applicable to WtE, a new domestic market could provide WtE with an additional revenue stream.

## 4.5 Challenges in Türkiye and how WtE can prepare

Scaling up WtE with CCS in Türkiye would require access to $CO_2$ transport and geological storage, supported by clear arrangements for permitting, monitoring and long-term liability. Türkiye currently has no dedicated CCS project or regulation. Its geology is nonetheless promising: studies have identified deep saline aquifers in Thrace, Central Anatolia and south-eastern Türkiye,[35] and the state-owned oil company TPAO has injected $CO_2$ for enhanced oil recovery (EOR)[36] at the Batı Raman field since 1986. Recent modelling suggests that industrial $CO_2$ could be stored within Türkiye's borders at avoidance costs of around €68–110 per tonne,[37] and the Marmara region could be a promising hub where waste, industry and potential $CO_2$ infrastructure coincide.

34. Republic of Türkiye, Official Gazette No. 32951, İklim Kanunu [Climate Law] No. 7552 (July 2025). [Link]
35. Okandan, E. et al., Assessment of CO2 storage potential in Turkey, modeling and a prefeasibility study for injection into an oil field, Energy Procedia 4, 4849–4856 (2011). [Link]
36. Sahin, S., Kalfa, U. and Celebioglu, D., Bati Raman Field Immiscible CO2 Application – Status Quo and Future Plans, SPE Reservoir Evaluation & Engineering 11(4) (August 2008). [Link]
37. Kumcu, S., Özyörük, B., Bezzo, F. and d'Amore, F., Optimization of carbon capture, utilization, and storage supply chains for the hard-to-abate industry in Türkiye, International Journal of Greenhouse Gas Control 150, 104568 (February 2026). [Link]

WtE plants can act as 'anchor' emitters for CCS hubs by producing a steady, predictable $CO_2$ stream all year round, which could de-risk shared $CO_2$ infrastructure. Until CCS networks are deployed, new WtE plants could be designed to be technically ready for CCS integration – reserving space for capture equipment, designing for heat integration, locating near potential $CO_2$ routes or ports, and measuring biogenic $CO_2$ fractions (Figure 6).

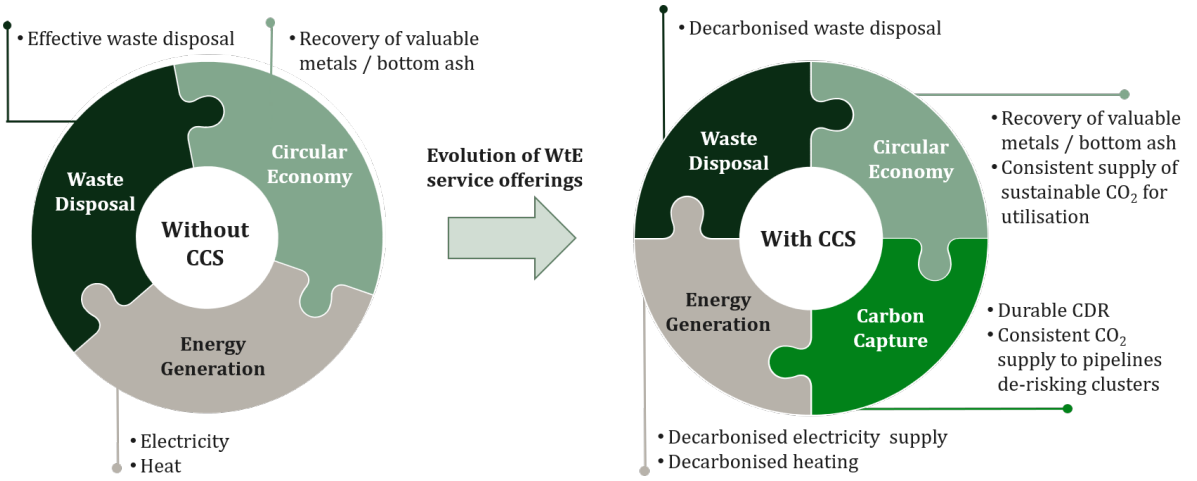



**Figure 6:** Evolution of the role of WtE with CCS integration

CHAPTER 5

# Access to green finance

## 5.1 Costs and revenue streams

WtE is capital-intensive. Recent projects point to investment of several hundred euros per tonne of annual waste-processing capacity: the Istanbul WtE plant, with a capacity of around 1 Mt of waste a year, has a reported cost of €466 million (Box 2),[38] while Belgrade's Vinča public–private partnership, which combines a 340,000-tonne-a-year WtE plant with a new landfill and the remediation of an old dumpsite, cost around €370 million.[39]

Against these costs, WtE plants earn several revenue streams: gate fees paid by municipalities (where the plant is privately owned) and businesses for waste treatment; sales of electricity and heat; sales of recovered metals and aggregates; and carbon credits or avoided carbon costs if CCS is installed. Landfill taxes can make WtE gate fees more competitive by raising the cost of the alternative – in England, the standard rate currently stands at £131 per tonne of waste.[40]

### Box 2: Istanbul, host of Türkiye's sole WtE plant

Istanbul Metropolitan Municipality's Waste Incineration and Energy Generation Plant in Eyüpsultan opened in November 2021 and is Türkiye's only large-scale WtE facility.[41] The plant was built by Hitachi Zosen Inova and Makyol. It is operated by the municipal waste company İSTAÇ, with Veolia acting as the operations and maintenance contractor.

The plant can treat 3,000 tonnes of household waste a day – around 15% of Istanbul's daily household waste. Its installed capacity is 85 MW, and it supplies electricity to around 1.4 million residents. The Municipality estimates that the plant avoids 1.38 $MtCO_2$ per year compared with landfill.[42] It does not export heat. In January 2025, a capacity expansion received a positive environmental impact assessment decision.[42]



**Figure 7:** Istanbul WtE plant[42]

The project received €74 million in equity from the Municipality and loans from the following institutions: the Asian Infrastructure Investment Bank (€100 million), the Black Sea Trade and Development Bank (€40 million), and BNP Paribas and Société Générale (€252 million, of which €172 million was covered by Swiss Export Risk Insur-

38. Asian Infrastructure Investment Bank, Türkiye: Istanbul Waste to Energy Generation Project – Project Summary Information P000495 (October 2021, updated November 2025). [Link]
39. Global Infrastructure Hub, Belgrade Solid Waste – case study (January 2021). [Link]
40. HM Revenue & Customs, Landfill Tax: increase in rates from 1 April 2026 (November 2025). [Link]
41. İBB, Atık Yakma ve Enerji Üretim Tesisi (accessed October 2026). [Link]
42. Istanbul Governorship, Atık Yakma ve Enerji Üretim Tesisi Kapasite Artışı – ÇED Olumlu Kararı (January 2025). [Link]

ance, SERV).[38] The project demonstrates that development finance institutions and export credit agencies are willing to back WtE in Türkiye.

## 5.2 Options for financing base plants and CCS retrofits

WtE with CCS raises two distinct financing problems. A base WtE plant is a mature technology with contractable revenues and can be financed as conventional infrastructure. A CCS retrofit relies on a still-emerging technology, and its revenues depend largely on policy and carbon markets. The two should therefore be financed separately but planned together.

### 5.2.1 WtE base plants

Two funding models have proved workable:

- **Municipal ownership with development finance:** the municipality owns the plant, contributing equity and borrowing directly, often through long-term loans at favourable rates from development banks or export credit agencies – such as İlbank in Türkiye – while operation can be contracted to a private firm. This model suits large metropolitan municipalities, as with the Istanbul WtE plant (Box 2); for smaller cities, regional plants shared between municipalities are an option.
- **Public–private partnership (PPP):** a private company designs, finances, builds and operates the plant under a long-term concession, recovering its investment through gate fees and energy sales, before handing the asset back to the municipality. Belgrade's Vinča project offers a good example. It is a 25-year PPP supported by a €260 million loan and guarantee package from the International Finance Corporation (IFC) and the Multilateral Investment Guarantee Agency (MIGA), alongside the EBRD and OeEB.[43] IFC's PPP advisory team structured and tendered the project for the city from 2014. Long-term heat sales to Belgrade's municipal utilities secured part of its revenues.[44]

In either model, lenders look for long-term waste supply agreements, offtake contracts for electricity (and ideally heat), a landfill tax that makes gate fees competitive, and revenue support for the energy produced. Türkiye already supports WtE-derived electricity through its YEKDEM feed-in tariff, which is paid for ten years; for thermal disposal in biomass-based facilities, the base tariff was set at TRY 0.50/kWh in 2021 and is periodically indexed, subject to a ceiling of US 8 cents/kWh.[45] Long-term, predictable support of this kind is central to bankability.

### 5.2.2 CCS retrofits

To date, no WtE CCS project has been financed on carbon-market revenues alone. In each case, the gap between CCS costs and the available carbon price has been closed by public support. Four main funding models have emerged:

43. IFC, IFC and MIGA Support Pioneering Waste-to-Energy PPP Project in Belgrade (October 2019). [Link]
44. ITOCHU Corporation, Launch of Commercial Operation of Belgrade Waste Management Public-Private Partnership Project (July 2024). [Link]
45. Bosca Hukuk (Mondaq), New Tariff in YEKDEM and Local Content Prices, Durations and Update Principles in Turkey (September 2024). [Link]

- **Grants or equity:** the government pays a share of the capital or operating costs directly, as a grant or equity, reducing the capital the developer must raise. In Norway, Hafslund Celsio's WtE CCS project received a €237 million grant from the central government and €247 million in equity from the City of Oslo.[46]
- **Fixed-premium contracts:** projects compete for long-term contracts that pay a fixed price per tonne of $CO_2$ stored. Examples include three CCS funding schemes run by Denmark between 2023 and 2026, which awarded contracts to five BECCS and cement CCS projects.[47]
- **Carbon contracts for difference (CCfDs):** the government signs a long-term contract that pays the project the difference between an agreed strike price and the other revenues received by the plant, on a per-tonne basis. The subsidy shrinks automatically as carbon prices in compliance or voluntary markets rise. Examples include the SDE++ scheme in the Netherlands, BECCS reverse auctions in Sweden[48] (three WtE plants selected in 2026) and UK CCS business model support (a contract offered to the Protos WtE plant).[49]
- **Tax credits:** the government reduces the operator's tax bill rather than paying cash directly. In the United States, the 45Q credit offers US$85 per tonne of $CO_2$ stored for 12 years. Credits can be sold to third parties, allowing developers to raise cash against them.[50] Canada, meanwhile, offers investment tax credits worth 37.5–60% of upfront capital investment across the CCS value chain.[51]

Any of these models can also be combined with long-term voluntary CDR offtake agreements. Ørsted, for example, stated that both the Danish subsidy and its offtake contract with Microsoft were needed to make its project viable.[52] Oslo's example also shows that municipalities can be co-investors in CCS, not merely hosts.[46]

For Türkiye, a phased and blended structure is the most realistic:

**Now:** finance base WtE plants on their own revenues.

**CCS planning:** use grants to co-fund front-end engineering and design.

**CCS retrofit:** offer CCfDs or fixed-premium contracts to make CCS projects bankable. To reduce the burden on the state, encourage the sale of CDR credits from the captured biogenic share and, in time, bring the fossil share of emissions into the Turkish ETS.

Public support for CCS in Türkiye need not come from the national budget alone. Possible sources include future Turkish ETS revenues, concessional finance from multilateral development banks and climate funds and, for the biogenic share, sales of removal credits to international buyers under Article 6 of the Paris Agreement.

46. Hafslund Celsio, Carbon capture in Oslo becomes a reality (January 2025). [Link]
47. Danish Energy Agency, CCS tenders and other funding for CCS development (accessed November 2026). [Link]
48. Bioenergy International, Three Swedish municipal BECCS projects awarded SEK 9.3B in support (October 2026). [Link]
49. Encyclis, Encyclis and UK Government sign landmark agreement on UK's first full-scale carbon capture project for Energy-from-Waste (September 2025). [Link]
50. Global CCS Institute, U.S. Preserves and Increases 45Q Credit in 'One Big Beautiful Bill Act' (July 2025). [Link]
51. Government of Canada, CCUS Investment Tax Credit (April 2026). [Link]
52. Ørsted, Ørsted awarded contract – will capture and store 430,000 tonnes of biogenic CO2 (May 2023). [Link]

CHAPTER 6

# Conclusions and policy recommendations

WtE can contribute simultaneously to Türkiye's energy, climate and environmental objectives by treating residual waste sustainably; recovering electricity, heat and materials; and achieving durable CDR when combined with CCS. Istanbul's WtE plant provides domestic implementation experience. Further development should be guided by regional residual-waste needs, lifecycle performance and access to enabling infrastructure. The priority is to identify projects that remain compatible with increasing prevention and recycling, can secure viable energy offtake and have a credible long-term route to retrofitting CCS.

The following recommendations are addressed to the Turkish Government, local municipalities and the finance sector to advance WtE in a responsible manner.

## 6.1 Recommendations for the Turkish Government

- **Increase enforcement against illegal dumping.** Review landfill disposal pricing and establish a phased pathway towards prices that reflect the true environmental cost of landfilling.
- **Translate existing waste-management targets into regional implementation plans** with measurable milestones for prevention, recycling and reduced landfill disposal.
- **Develop a national strategy for residual-waste treatment** that identifies regional capacity needs using alternative waste-generation and recycling scenarios, and reviews those needs as waste composition changes.
- **Require all new WtE plants to meet minimum energy-efficiency levels** based on best available techniques, so that sites are classified as 'recovery' rather than 'disposal' under the waste hierarchy.
- **Require new WtE plants to be CCS-ready** by setting aside space for capture equipment, implementing biogenic $CO_2$ monitoring and siting plants close to credible $CO_2$ transport and storage hubs.
- **Develop methodologies for WtE-related emission reductions and durable CDR** within the national crediting framework, to create private-sector demand and alternative revenue streams.
- **Advance national CCS capabilities** by funding $CO_2$ storage appraisal, establishing $CO_2$ transport and storage regulations, developing CCS financial incentive schemes and coordinating shared CCS infrastructure within industrial clusters.

## 6.2 Recommendations for municipalities

- **Adopt targets and feasible plans** to reduce the amount of residual waste sent to landfill.

- **Assess WtE within integrated waste-management and spatial plans**, matching plant capacity to suitable residual waste and considering proximity to heat users and potential $CO_2$ transport links.
- **Evaluate district heating and industrial heat supply** using local demand profiles, network costs and credible offtake arrangements before committing to plant design.
- **Develop project concepts that build a social licence to operate** – through transparent emissions reporting, community benefits and designs that integrate with the existing urban fabric.
- **Build internal capabilities** within municipal waste-management companies on the technical, financial, carbon-crediting and energy-export fronts.

## 6.3 Recommendations for financial institutions

- **Assess WtE financing** against residual-waste availability, lifecycle performance and the reliability of gate-fee and energy revenues, including municipal payment capacity and currency risks.
- **Support enabling investments** such as viable heat networks, industrial heat connections and shared $CO_2$ infrastructure, with financing aligned to their delivery schedules.
- **Develop blended and carbon-linked finance structures** that combine public support with long-term removal offtake agreements where appropriate.

## About ERM

ERM is the world's largest specialist sustainability consultancy. Founded in 1971, ERM partners with clients to operationalise sustainability and EHS at pace and scale, with more than 8,000 professionals in over 140 offices across 40 countries and territories. ERM has supported governments, investors and the private sector on carbon removals, CCS business models and WtE decarbonisation, including techno-economic, commercial and ESG due diligence.

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The Oxford Centre for Technology and Development (OCTD) is a technology commercialisation and capacity-building organisation working with academic, corporate and financial stakeholders to advance solutions to climate change. OCTD began in 2020 as a project-focused initiative to understand how emerging technologies could serve development and the challenges that stood in their way. Today, OCTD partners with high-impact companies as an ecosystem coordinator, creating the tools and platforms to bring the right technologies to the people and places that need them most.

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