Waste not, warm not

Exploring opportunities for decarbonisation in waste management

Regnan thematic investment insights

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In-brief

Waste management is a cornerstone of sustainable development with a multiplier effect on public health, safety and environmental outcomes. But it's also perceived as being a dirty business; and is often thought of as having a high carbon footprint.

In this report, Regnan's experts in water and waste and climate change provide answers to the questions:

1. **Where do greenhouse gas emissions arise along the waste management life cycle?**
2. **How are these emissions being managed?**
3. **What are the best ideas emerging in the sector to decarbonise waste management?**
4. **What can investors do to encourage low carbon transition?**

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Report highlights

Increasing focus on greenhouse gas emissions (GHG) in the waste management value chain presents many options for decarbonisation in the sector.

Waste collection is an important enabler of reuse, recycling, and composting – key ways waste emissions can be reduced. Fuel efficiency, use of alternative fuels and electric vehicles present options for decarbonisation.

Ambitious targets are evident among the sector leaders to increase electrification and efficiency.

- For example, Biffa plans to cease purchase of new fossil fuel vehicles by 2030 and to have no fossil fuel vehicles by 2040.

In landfill sites emissions depend on how the site is operated. State of the art processes and technologies can capture up to 90% of emissions and use captured landfill gas to produce renewable energy.

- The US EPA's calculator states a 5 MW project would save ~225,900 metric tonnes of carbon dioxide equivalent emissions (CO_2-e) per year - equivalent to carbon sequestered by ~1,325 km^2 of US forests in a year.

Many waste management companies have extensive reuse and recycling programs in addition to landfilling operations:

- For example, Waste Management Inc's comprehensive recycling program makes the company the largest post-consumer recycling company in North America.

There are interdependencies between waste management life cycle stages such that activities with low direct emissions rely on high emissions activities elsewhere in the value chain.

While divestment can shift high emissions activities out of portfolios, it does nothing to reduce the real-world impact of waste management.

That's why we see engagement with waste management companies as the best way for investors to contribute to waste decarbonisation.

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> A cornerstone of sustainable development is the establishment of affordable, effective and truly sustainable waste management practices in developing countries – Intergovernmental Panel on Climate Change, 2007.

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Introduction

As population, urbanisation and consumption grow, so does waste generation and with it the need for sustainable waste management. While individuals and companies are becoming more waste conscious, waste remains an inevitable by-product of life. Even under fully circular economic models, that utilise eco-product design to avoid waste from the outset and optimise for reuse and recyclability, material integrity declines through repeated cycles such that there will always be some waste to manage. As a result, both now and in the future, waste solution providers play a critical role in helping communities and industries dispose of waste in the most environmentally responsible and cost-effective ways.

The costs of waste collection are significant. However, the costs of ignoring waste are potentially much greater. The World Bank compared estimates of economic cost of uncollected household waste that is burned, dumped, or discharged to waterways, with integrated waste management costs for South East Asia. It found that basic waste management systems (meeting good international hygiene standards) equated to US$50–100 per metric tonne; far less than the economic cost of leaving waste untreated of US$375 per metric tonne.

Research evidences the multiplier effect of sustainable waste management on better public health, safety and environmental outcomes, including through reducing greenhouse gas emissions, prevention of pollution, conservation of natural resources and provision of renewable energy.

Even basic waste management systems provide ~4x economic and significant environmental and social benefits.

Regnan's SDG Taxonomy

Drawing on the 17 United Nations Sustainable Development Goals (SDGs) and their 169 underlying targets, we have built a comprehensive proprietary framework – the Regnan SDG Taxonomy. Our taxonomy takes the most pressing global environmental and social problems and links them to the solutions sold by companies today. Below we map investible waste solutions to the SDG targets to which they most strongly contribute.

Waste management's contribution to sustainable development

Issue

Population growth, rising standards of living, industrialisation and enhanced production and consumption of new products are together contributing to greater solid waste generation. The world generates 2 billion tonnes of municipal solid waste annually, with at least 33% of that not managed in an environmentally-safe manner. Issues relating to waste collection and removal are particularly acute in the developing world, where less than 50% of waste is collected in cities and only around 25% outside of urban areas.

The increasing volume and complexity of waste is creating a serious risk to ecosystems and human health, due to inadequate and ineffective waste management and disposal techniques. Poor waste management - ranging from non-existent collection systems to ineffective disposal - is a key contributor to significant air, water, marine and soil degradation. Moreover, unmanaged waste sites contribute to the contamination of drinking water and create breeding grounds for mosquitoes, resulting in poor health outcomes.

Solutions

Waste Collection

Effective waste collection and management infrastructure ensure materials are recycled and re-used, where possible, or safely disposed, supporting sustainable waste management. Management of hazardous waste is particularly important to reduce negative impacts on the environment via pollution and health of local populations.

Recycling and Reuse

Recycling and reuse is a core component of creating a closed loop system and optimising global resource efficiency in consumption and production. By producing new products from recovered materials, recycling saves a significant amount of energy during manufacturing and end-of-life treatment, and also reduces the volume of virgin resource extraction and attendant impacts.

Energy Recovery

A complementary solution to renewables and fuel switching in pursuit of global decarbonisation and sustainability goals, waste-to-energy plants involve burning of waste that could not be prevented or recycled. Generated energy that may replace energy sourced from fossil fuels. When compared to landfills, which release significant volumes of methane emissions, waste-to-energy can reduce GHG emissions. For example, Project Drawdown estimates approximately 2-3 gigatons of CO_2 can be reduced by waste-to-energy plants between 2020 and 2050.

Landfill Gas Capture

Effective management of landfills with gas collection systems can significantly reduce GHG emissions by, for example, capturing methane and recovering energy. Landfills which include liner, cover and leachate collection systems, environmental and post-closure plans - prevent degradation of water systems (from waste entering water streams) and air pollution.

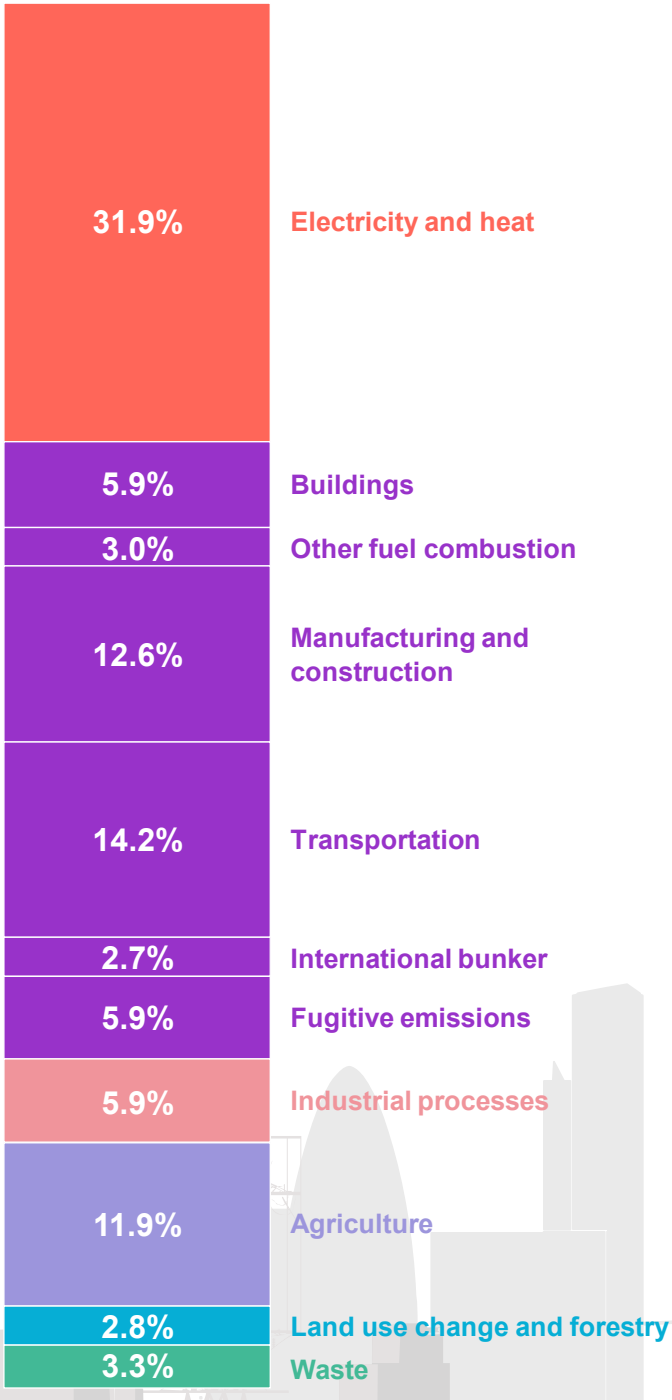
Waste emissions in context

While the broader sustainability credentials of effective waste management are readily acknowledged, there have been some lingering questions about the carbon footprint of waste management, which contributes about 3.3% of total global emissions, well below sectors such as agriculture, industrial processes, manufacturing and construction and buildings (see chart right).

Waste contributes ~3.3% of total global greenhouse gas emissions, with ~2% from landfills.

Although not the largest contributor, global decarbonisation goals need every sector to achieve reductions and low carbon transition is a critical question to examine for every investment.

World greenhouse gas emissions in 2018
Total: 48.9 $GtCO_2$-e



Source: Greenhouse gas emissions on Climate Watch, www.climatewatchdata.org. Latest data available.

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Regnan's Sustainable Value Assessment

Our in-house, proprietary ESG ratings approach – the Regnan Sustainable Value Assessment - considers climate transition as a core environmental factor.

We evaluate both the company's exposure to climate transition and how effectively it is responding – addressing risks and capturing opportunities. Key exposures and example responses are summarised in the table below.

Our approach benefits from over 15 years examining the link between ESG issues and investment outcomes and is supported by deep expertise in the team, expanded through thematic research and company engagement.

For more information about our Sustainable Value approach see www.regnan.com

Climate Transition

Exposures	Company Response
• Value chain carbon footprint • Regulatory drivers including carbon price risk • Changing customer preferences and expectations of stakeholders on GHG emissions	• Integration of transition risks into strategic decision making processes • Oversight of risks and responses by management and the board • Targets and milestones set to support transition to a low carbon economy business model • Transition risk management implementation and performance

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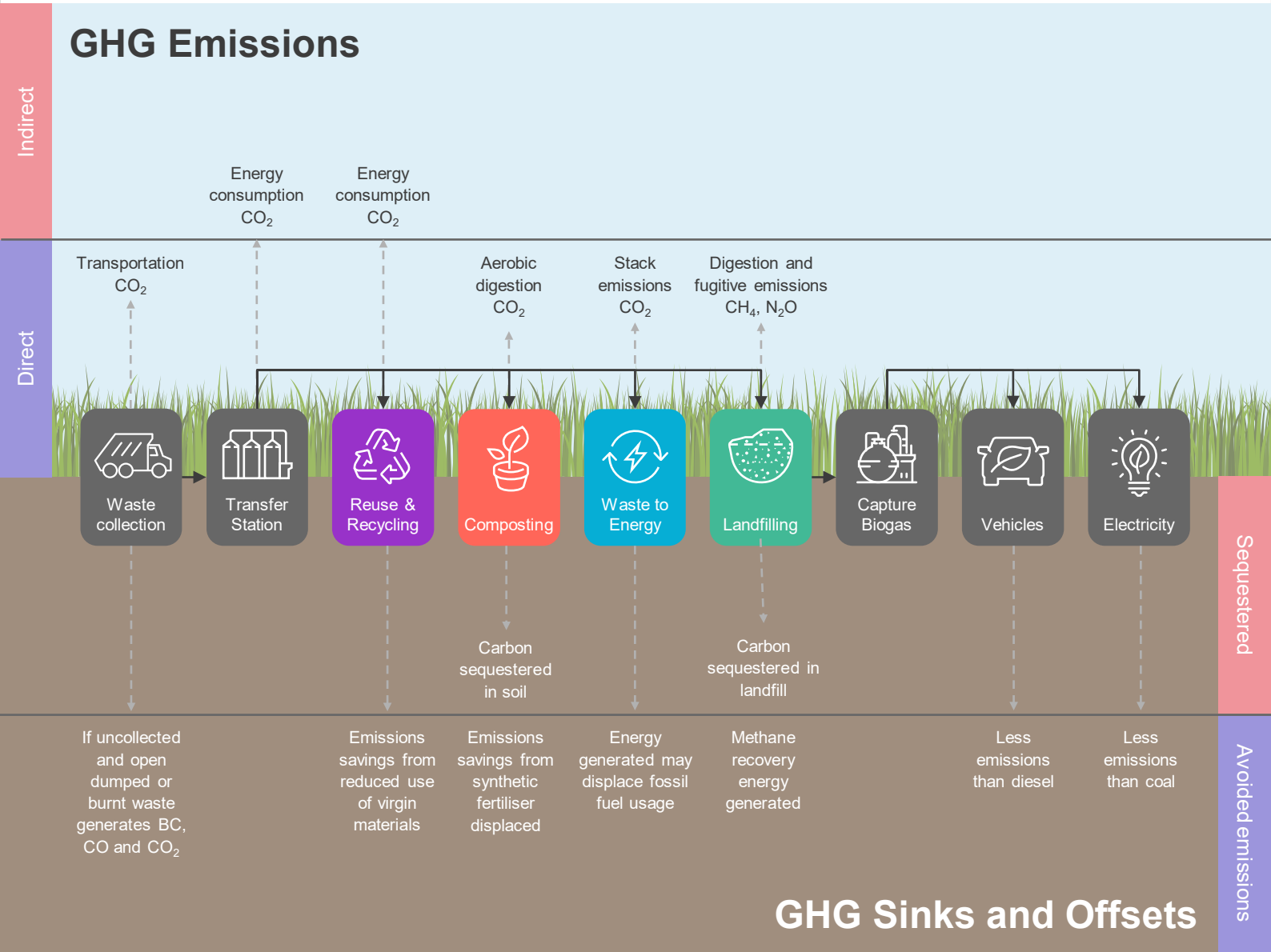
Carbon emissions footprint across the waste life cycle

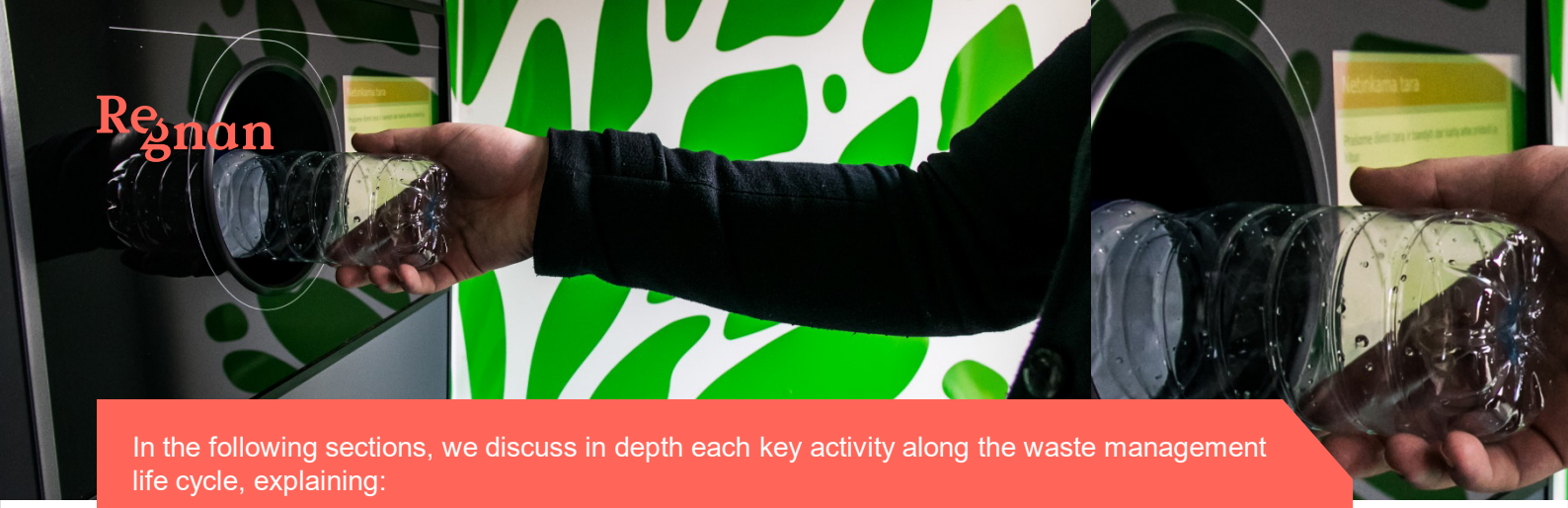
Emissions arise throughout the waste management value chain and over different time scales.

Waste collection contributes around 6-8% of emissions for an integrated waste management company involved across all life cycle stages. These emissions all occur in the year the collection occurs.

Landfills are the greatest share of the total emissions footprint: ~90% of total emissions for integrated waste management companies. These emissions are primarily from organic waste breaking down and releasing methane – a greenhouse gas that is ~28 times more potent than carbon dioxide. This is a slow process, with current year emissions arising from waste deposited over many years.

There are interdependencies between waste management life cycle stages such that activities with low direct emissions rely upon high emissions activities elsewhere in the value chain. For example, collection is an important enabler of reuse, recycling, and composting – key ways waste management emissions can be reduced.





In the following sections, we discuss in depth each key activity along the waste management life cycle, explaining:

1. **What's involved in this part of the waste management cycle,**
2. **How the companies involved are currently seeking to reduce emissions, and**
3. **How investors in the sector can encourage companies to accelerate decarbonisation and manage transition risks.**

Activity 1: Waste collection and sorting

Waste collection and sorting is a critical component in the efficient reduction of GHG emissions in waste management, enabling reuse, recycling, composting, energy recovery and landfilling of waste. It is also essential to meet waste regulatory requirements in many jurisdictions.

From data collected from integrated waste management companies such as Waste Management Inc and Republic Services, the proportion of emissions from waste collection, primarily from fleet vehicles, is relatively small at around 6-8% of total emissions.

Uncollected waste, which is more commonplace in developing countries, is either open dumped or burnt. Extensive research evidence shows these have serious adverse climate and sustainability outcomes:

- Uncontrolled leakage of waste to the environment from open dumping leads to localised air pollution including GHGs; release of leachate into the soil; and pollution of groundwater, rivers, lakes and oceans.
- Open dumping encourages pests and spread of diseases, for example dengue, malaria and yellow fever.
- Open dumping of solid waste contaminated or mixed with hazardous waste, electrical and electronic equipment, and industrial waste can have significant adverse environmental and health implications for the local population including pollution from hazardous metals, such as mercury and lead.
- Uncontrolled open burning releases pollutants like black carbon, carbon monoxide and other hazardous gases, with adverse health outcomes for local populations. Studies also evidence that open burning results in higher GHG emissions than landfilling.

Activity 1: Waste collection and sorting

What are companies doing to reduce emissions in waste collection and sorting?

Emissions can be reduced by:

- Using lower emissions fuels. Compressed natural gas is lower emissions than diesel, especially if it is sourced from biogas;
- Using software to optimise collection routes; and
- Upgrading trucks to more fuel-efficient models.

Substantial improvements in emissions intensity can be gained with these measures, for example:

- **Waste Management Inc.** reduced emissions per 1,000 miles driven by 31% from 2010 to 2019.
- **Republic Services** reduced fleet emissions by 7.5% in 2020 by using renewable natural gas.

In addition, several waste companies are trialling fully electric vehicles, for example:

- **Biffa** introduced 27 electric vehicles in partnership with the Manchester City Council.
- **Cleanaway** is trialling electric vehicles in Adelaide.
- **Republic Services** is testing residential collection in North Carolina with electric vehicles.

Such trials are important to understand the feasibility and reliability of electric vehicles in this sector, given strong potential emissions savings especially if powered with zero emissions electricity.

Advanced waste management companies also have ambitious targets to further increase electrification and efficiency, for example:

- **Waste Management Inc.** established a science-based target to reduce fleet emissions by 45% by 2038 (2010 baseline) with a milestone of converting 70% of the fleet to use compressed natural gas with 50% running on renewable natural gas;
- **Biffa** has established a target to introduce 10% of non-fossil-fuelled collection vehicles by 2025, to cease purchase of new fossil fuel vehicles by 2030 and to have no fossil fuel vehicles by 2040.

GHG emissions from electric vehicles are between 59 and 63% smaller than the emissions of ICEVs under current electricity mixes, with potential to generate reductions of 95% if electric vehicles are fuelled only by renewable technologies.

A 2021 feasibility study examined electric urban waste collection as a replacement to traditional internal combustion engine vehicles (ICEVs). By implementing a system simulation in Berlin, results showed that while transitioning towards a fully electric fleet corresponded to increases in costs of between 18 and 30%, GHG reductions between 60 to 90% are possible depending on the carbon footprint of the electric power source.

Activity 2: Reuse and Recycling

Reuse and recycling reduce GHG emissions by saving virgin materials and lowering the energy demand for production. Life cycle GHG emissions are usually lower in reused items when compared to those which have been recycled, unless materials must be transported over long distances.

Composting enables organic waste to be broken down aerobically, creating a product that can be used to improve soils. This can result in significant GHG emissions savings where it displaces synthetic fertiliser.

Recycling can yield substantial GHG benefits for materials that are energy intensive to produce such as steel, aluminium, and glass. For example:

- Recycled aluminium production requires only 10% of the energy required in primary production.
- Scrap-based electric arc furnace (EAF) steel production is around *half* as emissions intensive as production from EAFs using direct reduced iron, and *one third* as emissions intensive as steel produced from a blast furnace.

What are companies doing to reduce emissions in reuse and recycling?

Companies involved in recycling and reuse include specialists, such as **Copart**, **LKQ** and **Schnitzer**, and integrated waste management companies, such as **Waste Connections**, **Waste Management Inc.**, **Republic Services**, **Cleanaway Waste** and **Biffa**.

LKQ's operations include recycling operations in North America, recycling 90% of materials from "total loss" and end-of-life vehicles. LKQ operations include recovering salvageable parts to use in repair of other vehicles, fluids and tires which are recycled, repurposed or reused, and the sale of scrap metal to metals recycling companies.

The table below shows some of the materials processed and recycled by LKQ with indicative net carbon emissions savings based on the US EPA's "Waste Reduction Model". The total of all the CO_2 savings set out below is equivalent to removing annual emissions from ~97,000 passenger vehicles.

Item		CO_2 Emissions avoided metric tonnes of CO_2-eq
Tires	2,300,000	10,944
Materials Processed	Metric Tonnes	
Aluminium	32,000	209,709
Copper	21,000	85,901
Steel	64,300	108,049
Total		**~97,000 passenger vehicles' emissions pa**

North America's three largest integrated waste management companies – Waste Connections, Republic Services and Waste Management Inc. – all have comprehensive recycling and composting programs.

Waste Management Inc. is the largest post-consumer recycler in North America avoiding ~27 million $MtCO_2$-e per year. In 2021, the company signalled doubling investment to $200 million to augment its recycling capabilities and is now targeting to increase avoided emissions to ~35 million $MtCO_2$-e per year by 2038.

Veolia's PROCYCLE service recycles difficult to recycle items such as crisp packets, sweet wrappers and plastic toys utilising in-house expertise and network recyclers. This service provides a solution to maximise the recycling potential of hard-to-recycle plastics and avoid emissions.

Activity 3: Energy recovery

With room to landfill waste running out in some countries, energy recovery from waste incineration is expected to play an increasing role. In the European Union, waste incineration has increased from 36 million tonnes in 2000 to 60 million tonnes in 2019. There are some waste streams that can only be disposed of via incineration, like hazardous and contaminated materials.

Incineration of waste under controlled circumstances for the generation of energy has substantial GHG benefits compared to landfills according to the IPCC, emitting only around 1/10th equivalent GHGs and leading to more efficient energy extraction. Emissions savings are even greater where the use of this renewable energy displaces more emissions intensive sources like coal. Environmental performance can be improved by ensuring maximum reuse and recycling before energy recovery.

To demonstrate these benefits, assume just 1 of the 289 million metric tonnes of mixed municipal solid waste produced in North America in 2016 was combusted instead of being landfilled. Using the US EPA's WARM tool, we calculate a GHG benefit of 330,770 MtCO_2-e. This is equivalent to removing 70,227 passenger vehicles off the road.

Waste incineration in the European Union has increased from 36 million tonnes in 2000 to 60 million tonnes in 2019.

What are companies doing to reduce emissions in energy recovery?

Biffa diverts 500,000 tonnes of waste which cannot be recycled away from landfills to energy recovery facilities. The company's facilities will have a combined capacity of 750,000 tonnes. The facilities will produce 90MW of energy, sufficient to power 170,000 homes in the United Kingdom.

Waste Management Inc. has a proprietary organics recycling process which collects food waste from restaurants, schools, food processing plants and grocery stores to produce a renewable biogas.

Clean Harbors' Safety-Kleen business addresses the priority to maximise reuse before energy recovery, diverting waste lubricant oils that would otherwise be burned for fuel. Re-refining used oil displaces crude oil production providing carbon benefits. The company estimates on a life cycle basis that *8 kilograms of GHGs are saved through re-refining one gallon of used motor oil*, compared with one gallon of motor oil refined from crude oil. In 2019, the oil re-refining segment avoided over 1.8 million metric tons of CO_2-e.

Activity 4: Landfilling

Improving landfilling processes and technologies offers the most opportunities to reduce GHG emissions, with state of the art operations able to reduce emissions by up to 90%.

Landfill emissions arise primarily from organic waste breaking down into methane – a GHG that is ~28 times more potent than carbon dioxide. We discuss the importance of methane management to addressing climate change in our **Regnan Radar: Methane** available at regnan.com

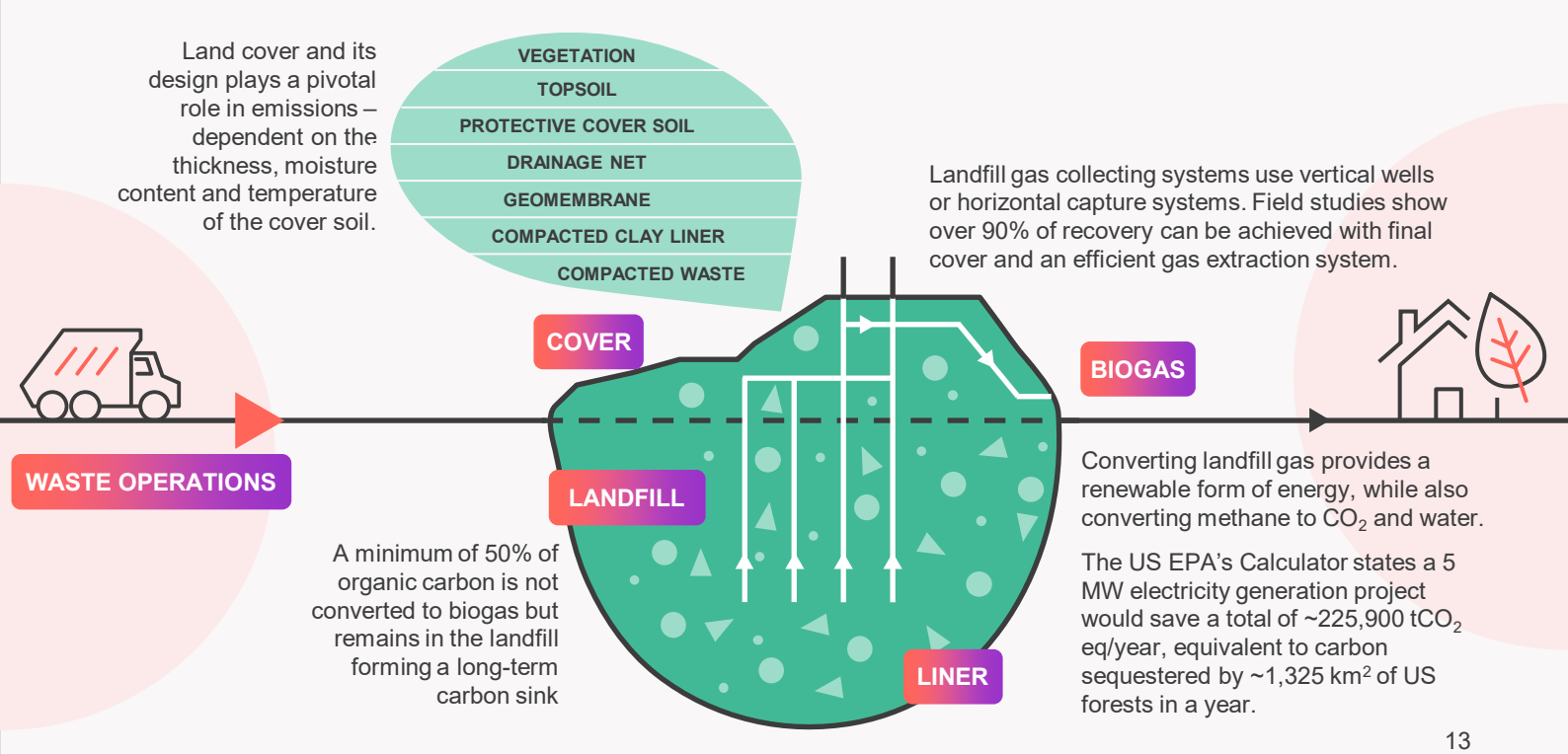
The volume of GHG emissions from landfill sites depend on how the site is operated; factors like whether it is an open dump or a controlled landfill, and the existence and type of gas collection system make a big difference. All of these factors can reduce the amount of methane and/or convert it to CO_2. Emissions of CO_2 from municipal solid waste landfills are not considered to contribute to global climate change because the carbon was contained in recently living biomass and the same CO_2 would be emitted as a result of the natural decomposition of the organic waste materials outside the landfill environment.

What are companies doing to reduce emissions in landfilling?

Waste Management Inc. converts landfill gas into energy at 124 sites, the company had 92 projects generating 538 MW of renewable electricity. The company also converts landfill gas into natural gas which is then distributed for use in residential and business settings and use in commercial vehicles including the company's own - 40% of the company's natural gas trucks use company produced gas. The company's renewable natural gas facility in Ferris, Texas has been injecting pipeline quality gas into the Atmos Energy system since 2020.

Republic Services Group has 69 landfill gas to energy projects. With beneficial use of biogas at 72.3 billion standard cubic feet, and a target of increasing this to 110 billion standard cubic feet by 2030. Renewable natural gas (from biogas) produces 70% fewer emissions than diesel.

Waste Connections has gas collection at 50 sites, from 28 of these sites landfill gas generates electricity, fuels local industrial facilities or fuels vehicles, annually processing 28.5 billion standard cubic feet of gas (equivalent to power 289,000 homes). The company has a target to increase recovery to 37 billion cubic feet of gas by 2033.



Source: Regnan, based on www.investor.republicservices.com and others

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How can investors accelerate decarbonisation of the waste management sector?

Given the interdependencies between waste management life cycle stages – with low emission activities dependent on high emissions activities elsewhere in the value chain – divestment can only shift high emissions activities out of portfolios; it does nothing to reduce the real world impact of waste management.

That's why we see engagement with waste management companies as the best way investors can contribute to the decarbonisation of the waste sector.

Engagement is a central plank of our active stewardship approach. Our engagements involve investment and subject matter experts from across Regnan. We set objectives for engagement in advance for individual companies, track progress, and transparently report to clients at least annually on the changes observed.

The table below sets out the key priorities we see for engagement with waste management companies on decarbonisation. Applicability will depend on individual company circumstances and performance.

Engagement Objective	Waste collection and sorting	Reuse and recycling	Energy recovery	Landfilling
Appropriate expertise, remuneration structures, capital allocation and governance in place to support effective decarbonisation activities	✓	✓	✓	✓
Decarbonisation goals are well supported by disclosed plans and interim targets	✓	✓	✓	✓
Piloting of EVs to set up initiatives for success/maximise decarbonisation	✓			
Calculation and disclosure of avoided and sequestered emissions uses appropriate and recognised methodologies with sufficient granularity to allow investors to monitor progress	✓	✓	✓	✓
Ambitious recycling/reuse targets		✓		
Evidence of lifecycle or equivalent analysis for reuse and recycling initiatives for better decision making on most efficient use of resources/energy		✓		
Prioritisation of non-recyclable fossil-based waste for energy recovery		✓	✓	
Consideration of carbon capture for energy recovery plants			✓	
Landfill covers and vertical/horizontal well systems are in place to capture landfill gas efficiently				✓
Implementation of interim measures ahead of EV rollouts where appropriate (such increasing fuel efficiency, alternative fuel use, enhance route planning etc.)	✓			
Customer/stakeholder feedback (on emissions) is actively sought to support effective stakeholder response and management	✓	✓		
Advanced technology is being used, for example in sorting (optical/smart) and refuse collection (smart trucks), to improve recycling capabilities	✓	✓		
Transparent participation in public policy	✓	✓	✓	✓

About Regnan

At Regnan we've been thinking forward and shaping the responsible investment movement since 1996 – long before it became mainstream.

2020 marked our expansion into funds management supported by the investment platform of J O Hambro and the Pendal Group. We've brought together proven sustainability and impact teams with track records tested through cycle, with the depth of insights provided by our engagement, advisory and research team.

Our collective purpose is to contribute to a more sustainable future by developing and promoting principled, rigorous and outcome-oriented approaches in responsible investment.

Client solutions sit at the heart of all that we do and are based on four key pillars:

- Delivering our clients attractive investment returns; we aim to grow their real wealth over the long term.
- Understand the materiality of sustainability issues to deliver improve decision-making and real world outcomes.
- Creating differentiated, innovative strategies that serve a purpose in client portfolios.
- Our strategies are authentic and provide significant exposure to underlying sustainability opportunities.

An ecosystem of leading investment and stewardship services

Investment services

Regnan Global Equity Impact Solutions

Investing in companies providing solutions to the world's underserved environmental and societal challenges

Regnan Sustainable Water and Waste

Investing in companies across the water and waste value chains

Client **solutions**:

Investment returns | Sustainability | Innovation | Purity

Engagement

Advisory

Research

Stewardship services

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