

**Decarbonising
our waste:**

Viridor's Roadmap
to net zero and net
negative emissions

Executive Summary

Tackling climate change is the defining issue of our generation. It demands action across every area of the economy, with no business able to ignore their responsibility to take action. Future generations will judge us on the decisions we make now – there is no time to lose.

The waste sector is no exception. Despite strong progress over previous decades to reduce greenhouse gas emissions and increase recycling rates, the rate of reduction has slowed in recent years as we reach the limit of what currently available technologies can deliver. The waste sector therefore still contributes around 6%¹ of annual UK greenhouse gas emissions – a proportion that has hardly changed in the last five years.

This is not sufficient as the country aims to reach net zero emissions by 2050. As a sector, we must go further, exploring every opportunity to reduce our environmental footprint by investing in new green technologies – such as carbon capture – and continuing to drive up recycling rates. In doing so, we can transform the problem of how we

dispose of our waste and build a net zero, circular economy where what we throw away is as important as what we buy in the first place.

As one of the leading UK waste companies, Viridor is determined to take a leading role in this transformation. Throughout our history we have put sustainability at the heart of all we do, investing in new technologies that cut our environmental footprint across the entire waste cycle.

But we now need to go much further. As the scale of the climate crisis increases, so must our ambition. In this roadmap Viridor commits to achieving net zero emissions across all our operations by 2040 and to align our ambition with the Paris Agreement through our commitment to the Science Based Targets Business Ambition for 1.5°C.

This new target positions Viridor as a leader in the decarbonisation agenda – but we believe we can go beyond it. Our aim is **to be a net negative emissions business by 2045** – in other words, we will remove more human related greenhouse gas emissions from the atmosphere than we create across our operations by 2045. If replicated across the sector, this would mean our industry can be an enabler of wider decarbonisation and offset emissions from hard-to-abate industries – ending the era where the country's waste is seen as an environmental problem.

Reaching these new targets will be no small task. It will require major investment across our business, including in new reprocessing facilities to increase the amount of waste that can be recycled. It will also require us to develop brand

new green technologies – such as combining carbon capture with our current Energy from Waste (EfW) facilities to create 'Waste Decarbonisation Facilities'.

Given the scale of our ambition, we do not yet have all the answers for how we will deliver it. Despite this, our approach will be more than mere warm words – we are therefore **publishing this Decarbonisation Roadmap** (Figure 1) that sets out how Viridor will go about transforming our business to deliver on our new net zero and net negative targets in the decades ahead. It reflects on the actions that we have already taken, as well as outlining our approach to doing much more in the years ahead.

We must reduce the waste we generate through product and packaging redesign and behaviour

change such as reuse. Even with ambitious reduction, reuse and recycling targets, there will still be a significant proportion of non-recyclable waste that needs to be managed and for which there are currently limited options (Figure 2). Therefore, as the roadmap shows, our priority focus is on addressing carbon emissions from our EfW fleet. These represent 63% of our Group emissions and are widely recognised as being in a 'hard to abate' category. This means that to address them will require Viridor to play a pro-active role in catalysing new technologies for capturing emissions, working in partnership with the Government and industry.

Alongside this overarching roadmap, we are developing emissions reduction action plans for each of our business functions that will set out a detailed framework

for how we will deliver our group-wide goals. We will closely involve our key stakeholders as we develop these detailed plans, including our customers and suppliers who are so critical to everything we do as a business.

While the scale of the challenge is significant, the ultimate prize will be transformational. Failure is simply not an option and the publication of this roadmap is the first step as Viridor commits to becoming a more sustainable waste and recycling business that can help drive the country's net zero transition.



Figure 1: Roadmap summary graphic

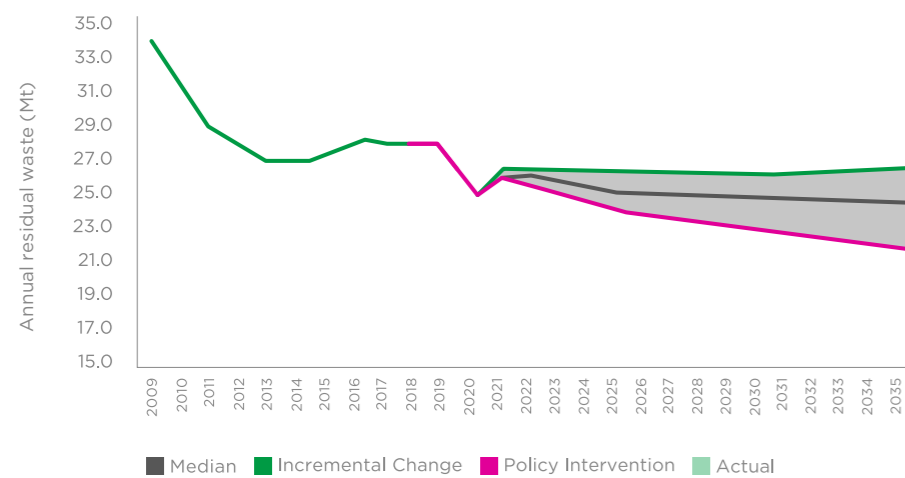
¹ The Sixth Carbon Budget – Waste, Climate Change Committee, 2020, www.theccc.org.uk/wp-content/uploads/2020/12/Sector-summary-Waste.pdf



The Context: Environmental impact of the waste sector

The UK generates more than 220 million tonnes of waste every year². Of this, 12% is household waste, which is Viridor's core business. In 2018, homes produced 26.4 million tonnes, of which around half - 11.9 million tonnes - was recycled and turned back into new products. The other half was either landfilled or treated in EfWs.

Figure 2: UK Residual Waste Projections³ (Mt), Tolvik (2021)



Incremental Changes: a scenario in which modest incremental improvements in recycling and resource efficiency are seen, driven by a combination of social attitudes and relatively 'light touch' legislative changes.

Median: A scenario in which key elements of the strategy (and policies for the devolved regions) are eventually delivered, but beyond which there is limited progress.

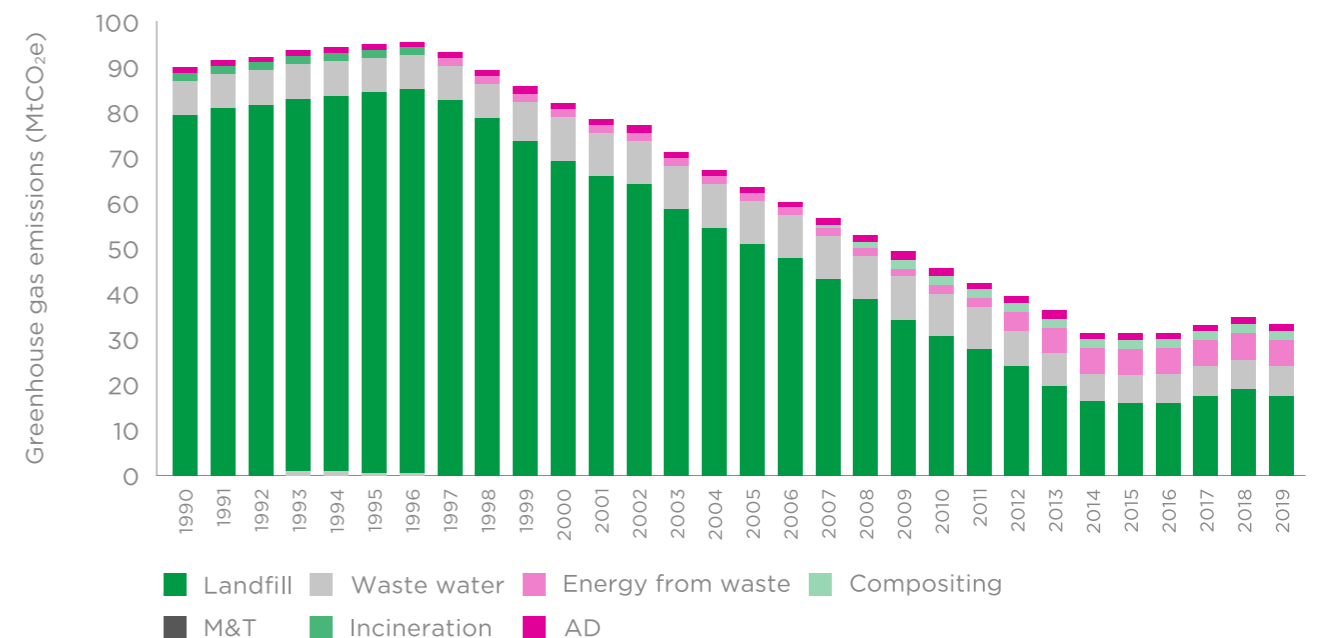
Policy Intervention: a scenario in which there is legislative and fiscal support for sustained action on recycling and prevention to deliver recycling performance in line with other leading countries in Northern Europe.

For the past 20 years Viridor, along with the wider waste sector, has been focused on driving the move away from landfill to recycling and energy recovery. This has been critical in improving the environmental control of waste management and making sure the resources we use go further for longer - with the

ultimate goal of bringing an end to the 'buy-use-throw' society. In 2019 the total tonnage of Residual Waste sent to EfW facilities in the UK exceeded the tonnage sent to landfill for the first time - a landmark moment⁴. The vital role our sector plays in the economy - ensuring that

the country's waste is safely and effectively managed - has transformed over almost three decades. The development of comprehensive recycling and the move away from landfill has seen emissions fall by almost two thirds (63%)⁵ between 1990 and 2019 (Figure 3).

Figure 3: Breakdown of waste sector emissions⁵

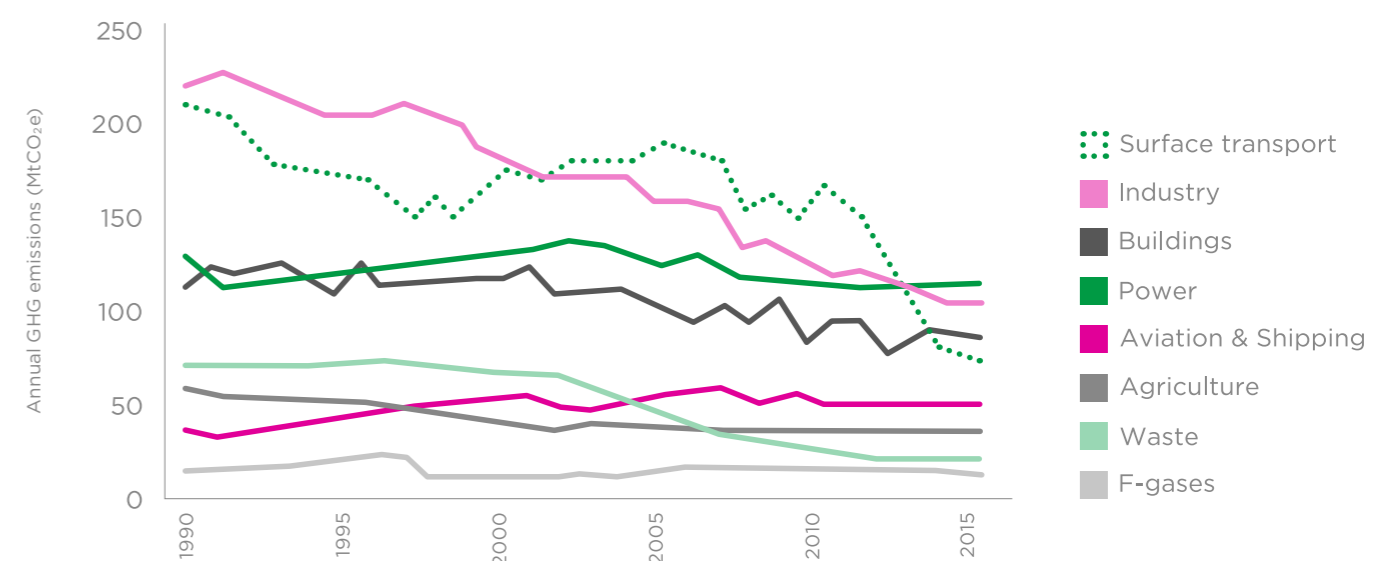


Viridor has led the way in applying new technologies to reduce the environmental impact of the waste sector. As a significant proportion of waste is still non-recyclable (see Figure 2) and constantly extending landfill is no longer a viable option,

this includes building world class EfWs, which safely treat non-recyclable waste and turn it into power and heat and investing in state-of-the-art plastics reprocessing facilities that halve the emissions of plastics compared to new materials.

The climate crisis facing the planet means that we now need to go much further. Despite the progress, our sector is still the seventh largest emitter of greenhouse gasses in the UK, with emissions largely unchanged over the last 5 years (Figure 4).

Figure 4: Territorial UK GHG emissions by sector (MtCO₂e)



²UK Statistics on Waste, DEFRA, 2020, assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/918270/UK_Statistics_on_Waste_statistical_notice_March_2020_accessible_FINAL_updated_size_12.pdf

³Residual Waste refers to the fraction of municipal waste remaining after the source separation of municipal waste fractions such as food and garden waste, packaging, paper, metals and glass; Municipal Waste includes Household Waste as well as waste generated by most of the commercial premises. (UK Energy from Waste Statistics, Tolvik, 2021)

⁴UK Energy from Waste Statistics, Tolvik, 2021, www.tolvik.com/wp-content/uploads/2021/05/Tolvik-UK-EfW-Statistics-2020-Report_Published-May-2021.pdf

⁵The Sixth Carbon Budget - Waste, Climate Change Committee, 2020, www.theccc.org.uk/wp-content/uploads/2020/12/Sector-summary-Waste.pdf

By diverting waste from landfill, Viridor reduces the UK's waste emissions by 650 ktCO₂e⁶ per year. However, the emissions from processing all of the non-recyclable waste we take in from around the country are still substantial. In Financial Year (FY) 2019/20 our Scope 1 and Scope 2 emissions (the anthropogenic direct emissions from our assets and indirect from energy we purchase) were 2.1MtCO₂e, of which those associated with EfW operations were 1.34MtCO₂e. This figure has since risen to 1.6MtCO₂e following

commissioning new facilities, such as Avonmouth EfW, during the FY 2020/21. Nearly two thirds (63%) of our anthropogenic emissions come from the energy recovery activities (Figure 5) and, within that, almost all of these emissions (98%), are a result of non-recyclable waste combustion (Figure 6). We will continue to support and advocate for maximising recycling and reprocessing. For residual waste however, tackling the emissions from EfW is our most critical focus for ending our contribution to climate change.

Reaching net zero emissions across the economy by 2050 will require every sector of the economy to transform to a low-carbon model. But we cannot wait to act: the faster we are able to reduce emissions now, the greater our chance of averting the most catastrophic impacts of climate change and leaving better planet for future generations. Viridor intends to play its part, leading the transformation of the waste sector to become an enabler of a net zero economy.

Figure 5: Viridor's anthropogenic emissions (Scope 1 and 2), FY 2019/20

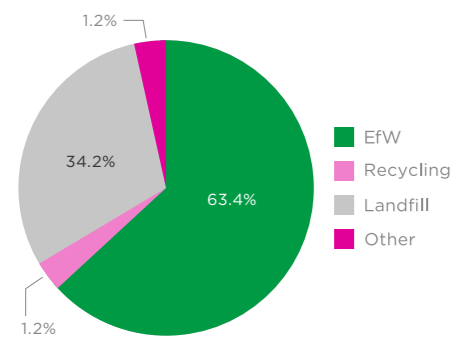
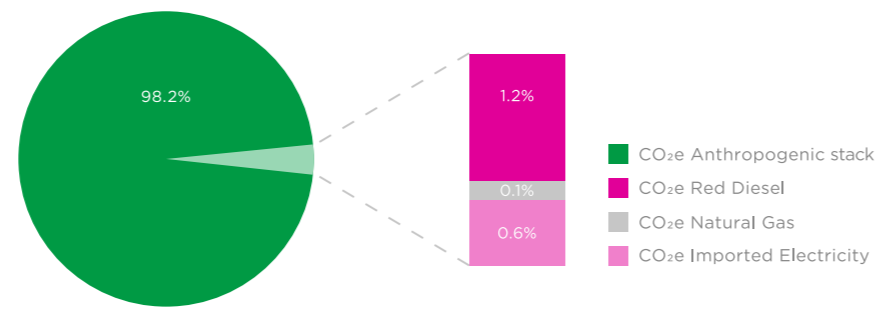


Figure 6: EfWs anthropogenic emissions (Scope 1 and 2), FY 2019/20

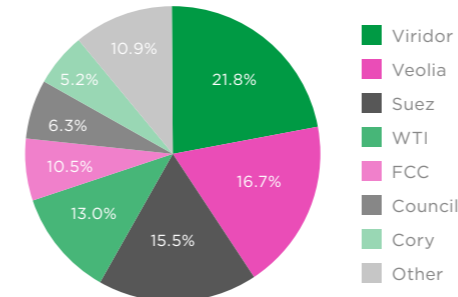


A history of investment in new technologies

It has been clear for at least the last two decades that landfill is unsustainable. In early 2000 Viridor began investing in alternatives, commissioning its first EfW facility in 2010. Today Viridor operates the largest share (22%) of the UK EfW market⁷, with the capacity to divert 3 million tonnes of non-recyclable waste from landfill.

The next major technological step forward was reprocessing of waste - turning plastics back into raw materials for making new bottles and packaging. Approximately 7.9% of each tonne of waste is dense plastics (PET, HDPE and other)⁸. If this plastic could be removed and recycled before the waste enters an EfW, the anthropogenic carbon footprint would reduce by 33%. As technologies have improved, Viridor has adopted them - we are currently completing our second plastics reprocessing facility, which will be the largest plant of its kind in the UK. This is a key pillar in building a circular, low carbon economy; not only will this new facility enable us to end our export of plastic for recycling abroad, it is critical to divert fossil-based materials away from our EfWs to reduce their anthropogenic emissions.

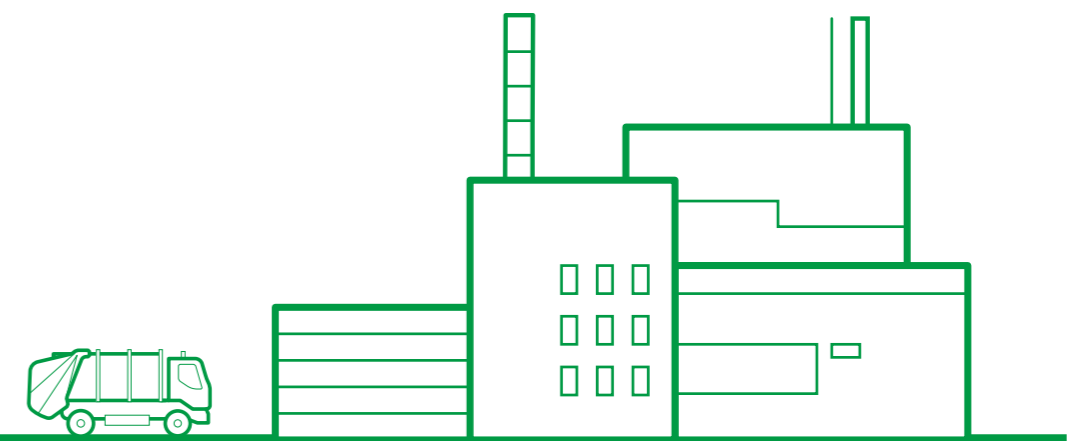
Figure 7: 2020 EfW Operator Market Shares⁷ (input, kt)



Maximising energy from waste efficiency

The efficiency with which we treat waste is important. Waste Processing Facilities are known as EfWs (Energy from Waste), with the **most efficient of these categorised as Energy Recovery Facilities (ERF)**. ERFs meet an energy efficiency threshold defined by the environmental regulator as 'R1' status, reflecting the higher level of energy recovered from waste.

Nine of Viridor's eleven EfW facilities are advanced ERFs: we have invested over £1.2 billion in their development to date. In FY 2020/21 our facilities exported 1,837GWh electricity - enough to power the equivalent of 517,332 homes. To make this document simpler to read, we will refer collectively to all of our facilities as EfW.



⁶ CO₂ is the most common greenhouse gas emitted by human activities, in terms of the quantity released and the total impact on global warming. As a result, "carbon dioxide equivalent" or "CO₂e" is sometimes used as a shorthand expression for all greenhouse gases. CO₂e is a term for describing different greenhouse gases in a common unit. For any quantity and type of greenhouse gas, CO₂e signifies the amount of CO₂ which would have the equivalent global warming impact.

⁷ UK Energy from Waste Statistics, Tolvik, 2021, www.tolvik.com/wp-content/uploads/2021/05/Tolvik-UK-EfW-Statistics-2020-Report_Published-May-2021.pdf

⁸ Greenhouse Gas and Air Quality Impacts of Incineration and Landfill, Eunomia, 2020, cdn.ca.emap.com/wp-content/uploads/sites/6/2021/03/Greenhouse-Gas-and-Air-Quality-Impacts-of-Incineration-and-Landfill.pdf

Our Ambition

We are determined to play a leading role in transforming the waste sector so it can be a driver of creating a net zero, circular economy by 2050.

Viridor is committed to achieving net zero emissions in line with the Science Based Targets Business Ambition for 1.5°C pathway. However, while this is critical, our ambition is to go further, becoming the first net negative emissions waste and recycling company in the UK - removing more anthropogenic greenhouse gasses from the atmosphere than we emit.

To achieve this, we will:

- Reduce direct emissions from all our core operations
- Maximise the amount of waste that is recycled
- Capture and store carbon emissions from our strategic sites
- Generate negative emissions by expanding carbon capture to our national network of sites, alongside exploring new products that can be created from CO₂ waste stream
- Supply more homes and businesses with clean heat

By minimising the emissions that we generate and then capturing the emissions that remain, Viridor can achieve net zero carbon emissions by 2040 - a decade ahead of the UK emissions target. This will require the use of Carbon Capture Utilisation and Storage (CCUS) technologies and the Carbon Capture and Storage (CCS) infrastructure that the UK Government has initiated around the country and where our facilities are strategically located.

CCS will capture both anthropogenic (fossil) CO₂ as well as the biogenic CO₂. Biogenic CO₂ is net zero in itself (see boxout on page 12), which means that as each of our facilities implements CCS, they will become net negative by the volume of biogenic CO₂ captured.

Delivering negative emissions will enable Viridor to play a role in mitigating the climate impact of other hard to decarbonise sectors, such as aviation or shipping, contributing to the UK's overall net zero by 2050 target.

Our Plan

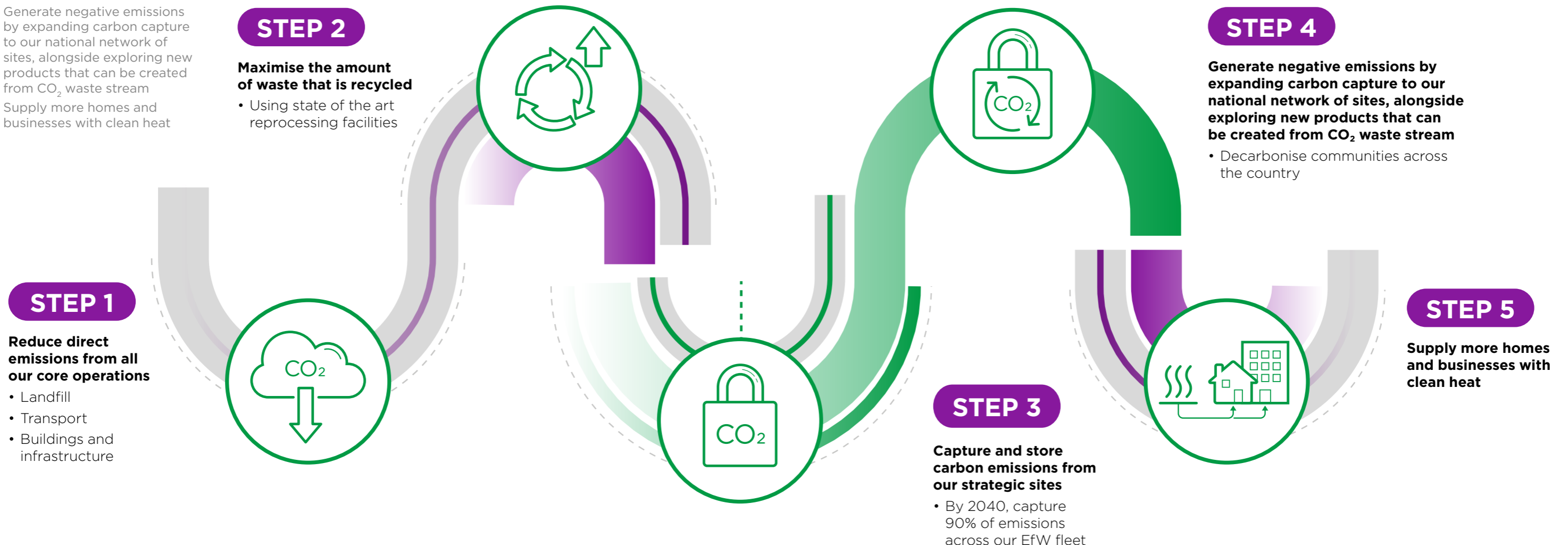
Control what we can, work in partnership to address what we cannot.

Unlike many other sectors, the waste sector is not in control of the material it receives. The quality of the recycling and the contents of the non-recyclable waste is determined by the choices, processes and policies of manufacturers, packagers, consumers, local authorities and businesses.

The waste sector in any country is the product of policy and regulation that tries to effectively manage what we no longer need or want. Regulation drives the markets and investment that make the sector we have today and will be critical to further transform it.

Delivering our ambition demands that we take our own ambitious action but also that we work in partnership with the Government and industry, engaging with those involved in areas from product design to policy, to achieve co-ordinated and complimentary actions.

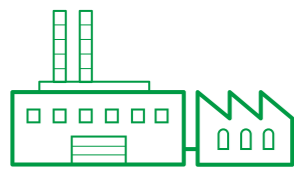
Our five-step plan seeks to maximise all reductions under our control, across our operations, then proactively address the emissions that flow from all our relevant stakeholders.



Step 1. Reduce direct emissions from all our core operations

The details of this will be published on a business-unit level

Buildings and infrastructure - through committing to sustainable and low carbon construction for new build projects; maximising self-sufficiency of power and heat where viable and driving the energy efficiency of all infrastructure including offices.



Transport - though decarbonising the waste collection, transport and logistics fleet as well as the 'yellow plant' vehicles at our sites; introducing smarter working to reduce and green our travel; and developing and delivering solutions eliminating shipping of waste overseas.



Landfill sites - through diverting organic waste from landfill; exploring advanced mechanical pre-treatment combined with aerobic bio-stabilisation and enhancing capture and utilisation of landfill gas.

Step 2. Maximise the amount of waste that is recycled

The best way to cut emissions is not to produce them in the first place. Therefore, a critical element of reducing the impact of recycling and waste management on the environment is simply generating less and ensuring that what is produced can be recycled and reused.

Viridor is already investing in new state-of-the-art reprocessing facilities to turn waste back into raw materials. We have ambition to do more and to tackle the more challenging plastics such as films and, by doing so, to divert those materials from our EfWs.

The UK Government's reforms of packaging design and recycling policy are critical. Viridor supports the Climate Change Committee's recommendations for increased ambition for a 70% recycling target by 2030 (rather than the current 65% by 2035).

Even with high rates of recycling and better packaging we will still have residual fossil content in non-recyclable waste. Eunomia estimates that plastics will still account for c. 17% of residual waste in 2035 if the 65% recycling target is met⁹ (Figure 8).

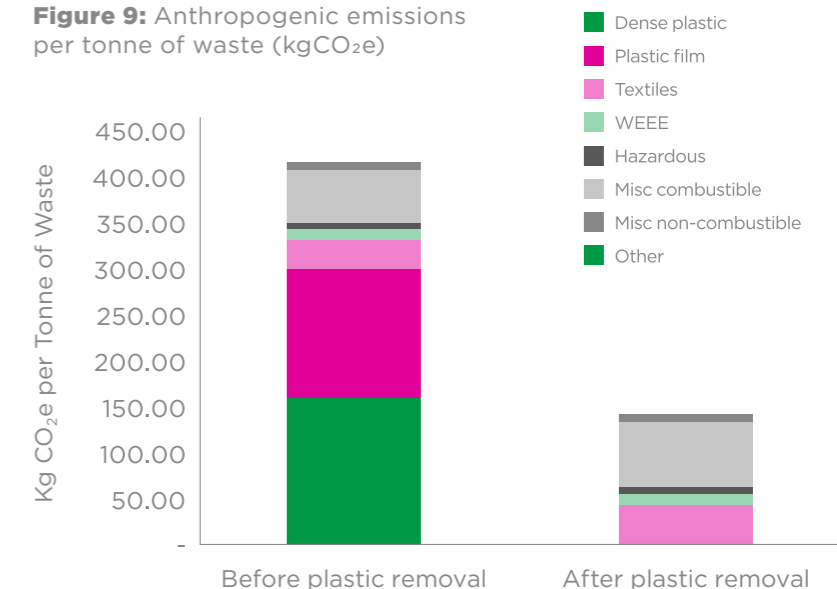
Viridor is exploring ways to extract material - such as plastics and textiles - and consider other processes for its use. In the longer-term we hope to supply material for application by novel technologies that use these materials to make new products. However, these technologies are in their infancy, therefore, we are committing via our annual reporting cycle to provide updates on our success and associated investments.

In one tonne of waste 16% of plastic material accounts for 70% of the anthropogenic footprint, demonstrating the significant potential for reductions if we are able to completely separate the dense plastics and plastic film from the waste processing stream (Figure 9).

Figure 8: Municipal Residual Waste Compositions in 'Today' and 'Expected' 2035 (65% overall municipal recycling rate) scenarios⁹

Material stream	Scenario / %	
	Today	Expected - 2035
Paper	14.7	11.7
Card	6.3	4.9
Plastic film	8.3	9.4
Dense plastic	7.9	7.7
Textiles	5.5	8.4
Wood	2.3	3.5
Nappies & sanitary	4.0	6.5
Other misc. combustible	5.3	8.4
Other misc. non-combustible	3.8	5.4
Glass	2.8	3.3
Ferrous	2.4	3.7
Aluminium	1.2	0.7
Weee	1.1	1.3
Potentially hazardous	0.5	0.8
Garden waste	2.7	3.1
Kitchen waste	26.4	15.1
Other putrescibles	2.5	3.7
Fines	2.3	2.3

Figure 9: Anthropogenic emissions per tonne of waste (kgCO₂e)



⁹Greenhouse Gas and Air Quality Impacts of Incineration and Landfill, Eunomia, 2020, cdn.ca.emap.com/wp-content/uploads/sites/6/2021/03/Greenhouse-Gas-and-Air-Quality-Impacts-of-Incineration-and-Landfill.pdf

Step 3. Capture and store carbon emissions from our strategic sites

Steps 1 and 2 will maximise reprocessing and removal of residual fossil content – making the most of the waste resources we have. However, this alone will not take the waste sector to net zero emissions and we must therefore go much further.

Based on currently available technology and the Government's planned roll-out of CCS, we believe that by 2035 it should be possible to have implemented CCS at our four key EfW operations around the UK – Runcorn, Trident Park, Avonmouth and Dunbar.

Achieving net zero operations across these sites will capture 1.6MtCO₂. We are focussed on sites nearest the Government's proposed carbon capture clusters, with our first being at Runcorn, which currently emits c. 0.9MtCO₂ per year. As part of our commitment, Viridor is joining the HyNet Carbon Capture Consortium in North West England.

Step 4. Generate negative emissions by expanding the carbon capture across our national network of sites, alongside exploring new products that can be created from CO₂ waste stream

Getting to net zero will be a huge step. Like steel and cement manufacture, the waste sector is hard to abate. A credible route to net zero is an exciting path and one Viridor is determined to lead. But the ability to capture biogenic carbon allows us to go further.

Expanding carbon capture to all of our sites will take Viridor to net negative emissions, with the potential to capture up to 1.35Mt of biogenic CO₂. As a result, the energy we generate will be net negative emissions – the heat and the power we make to supply

homes and businesses. In this way Viridor will start to decarbonise its local communities across the country.

We anticipate that over the next decade carbon capture and usage (CCU) technologies will develop at a commercial scale. CCU will convert concentrated CO₂ into new products and limit the need for CO₂ storage. As a business focussed on maximising resource reuse, known as the circular economy, we are committed to exploring these technologies as they emerge.

To reduce our reliance on CCS infrastructure and ensure that we continue to progress our vision of a world where nothing goes to waste, CCS will be limited to our strategic sites close to relevant UK facilities: our remaining net negative drive will be through CCU. We will invest in CCU technologies and pilots. We will detail progress through our annual reporting cycle.

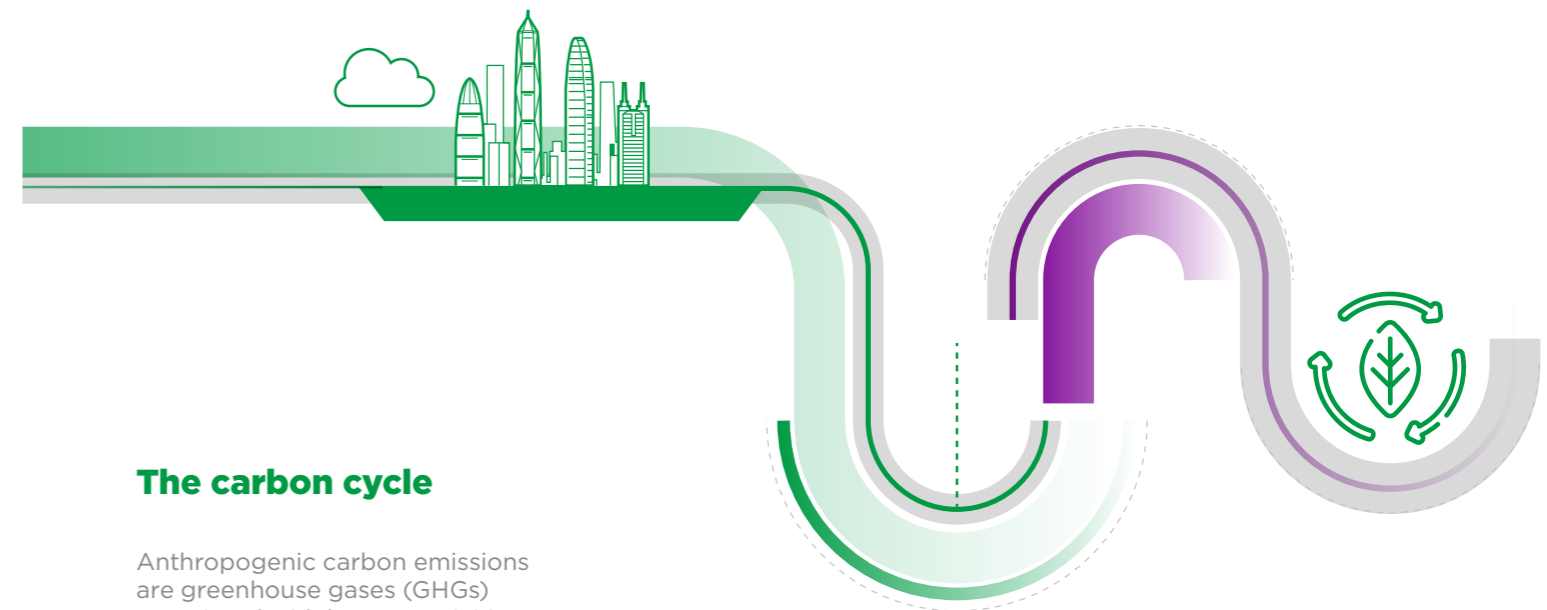
Step 5. Supply more homes and businesses with clean heat

Given the significant investment needed to deliver our plan, it is important that all recovered energy from our EfWs is used effectively. Decarbonising heat is one of the most challenging aspects of the domestic energy decarbonisation agenda, and we want our clean heat to be used to full effect.

Our Runcorn facility has been targeted as our first CCS-enabled plant – we are investing £400,000 on feasibility work. Runcorn already supplies industrial steam and would be one of the first installations to supply clean heat. We have agreed a partnership with Vattenfall to explore heat networks our EfWs

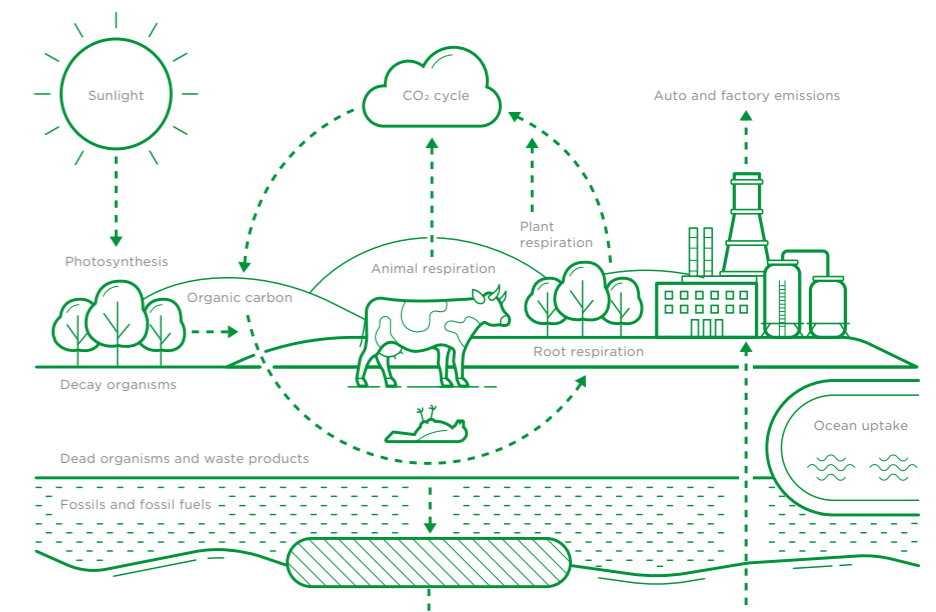
can supply and we are keen to do more. Heat networks in towns and cities can be an effective option for clean heat supply.

With a reliable supply of baseload clean heat, Viridor will be a catalyst for decarbonising our communities.



The carbon cycle

Anthropogenic carbon emissions are greenhouse gases (GHGs) associated with human activities, such as burning fossil fuels or deforestation, that result in a net increase in emissions. Biogenic carbon is a function of the natural carbon cycle, where emissions are sequestered from the atmosphere by plants during growth and are usually released back to the atmosphere later, due to decomposition. As a result of this 'netting out' effect, the GHG Protocol's accounting rules treat biogenic CO₂ emissions separately. When Carbon Capture Utilisation & Storage is implemented, the biogenic CO₂ emissions we capture create a net reduction in overall emissions. Such activity contributes to overall reductions across the wider economy. Once we have fully implemented CCUS where we can, Viridor will achieve net negative status.



Partnership is key

Our ambition is bold: Viridor is already investing in R&D to explore CCS, plastics removal and heat networks. We are prepared to make significant investments in the associated infrastructure for these areas, however, our ability to do this at scale will require working on the basis of a predictable policy framework that enables long-term, low-risk infrastructure contracts to be signed.

We are acutely aware of our reliance on CCS technologies that require government and regulatory intervention. Other critical dependencies rely on the actions of other parts of the waste system, such as packaging redesign to increase reuse or effective collection systems that

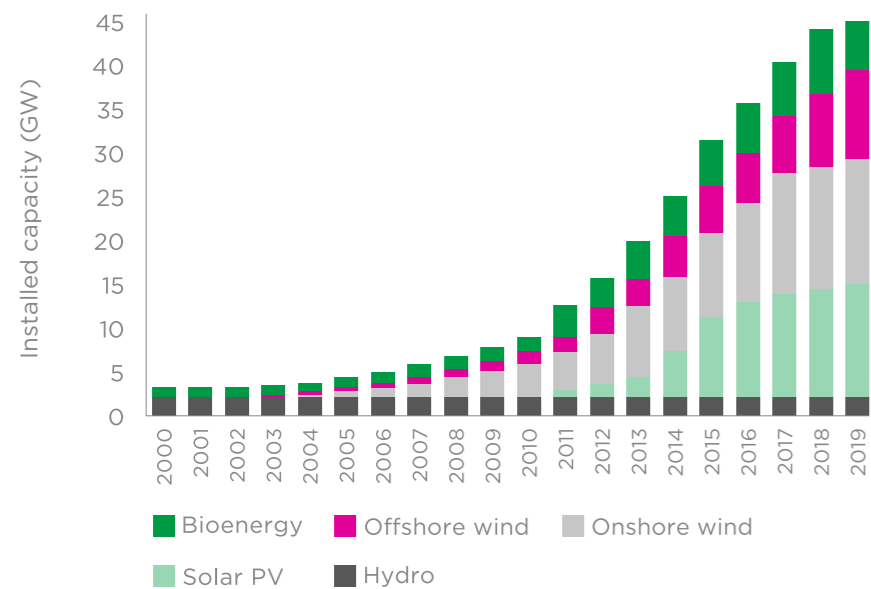
enable householders to increase both the volume and efficiency of recycling.

The UK Government has a successful track record in using policy to reorientate investment - including the use of Contracts for Difference (CfD) for wind and solar which proved to be an effective mechanism (Figure 10) to drive the investment. We are working closely with the Government to consider how the policy and regulatory framework can support major investment across the waste sector to deliver on our net negative aspirations. Achieving a net zero and net negative emissions business depends on an effective partnership with the UK and devolved Governments,

where Viridor can bring UK wide investment and job creation and where policy creates long-term arrangements that cause infrastructure contracts to become the norm. In his landmark report on the economics of climate change in 2006, Lord Stern described climate change as a market failure. The role of policy is to correct that market failure to drive investment in the net zero emissions future we know the science demands.

Viridor is committed to invest in the solutions; it will be vital to have the right policy environment to ensure capital can be mobilised at scale. As in energy and transport, policy reforms will be a key determinant in realising our vision on the desired timeline.

Figure 10: Commercially-oriented policy intervention as a successful model for scaling low carbon technologies - Renewable power generation rapid capacity increase driven by the adoption of the CfD scheme.¹⁰



How we will demonstrate progress

Any credible plan depends on a commitment to transparency and regular reporting. Viridor is already a sector leader through publishing a comprehensive annual sustainability report and disclosing our carbon emissions:

- Viridor's carbon footprint (CO₂e) will continue to be reported on a quarterly basis according to the internationally recognised Greenhouse Gas Protocol (Corporate Standard) Methodology.¹¹

- Viridor's annual carbon data will continue to be publicly disclosed following independent external verification via the annual Sustainability report and also Director's report for the Streamlined Energy and Carbon Reporting compliance.
- The development of our plans is underpinned by our commitment to the Science Based Targets Business Ambition for 1.5°C.

- Due to the nature of technology implementation and our anticipated growth, our decarbonisation strategy will not deliver a smooth, linear reduction in emissions. We envisage significant falls in emissions when new CCS plants come into operation followed by periods of little change while new plants are constructed. To give a representative picture of the work done we will report annually on our trajectory and latest status of implementation in the context of more comprehensive five-yearly plans.



¹⁰Digest of UK Energy Statistics (DUKES): renewable sources of energy, National Statistics, assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/904823/DUKES_2020_Chapter_6.pdf

¹¹Greenhouse Gas Protocol, Corporate Standard, www.ghgprotocol.org/corporate-standard

Building a world
where nothing
goes to waste

