

Carbon Capture: A Wasted ~~Opportunity~~ Opportunity.

Executive Summary

Energy from Waste with Carbon Capture provides the only domestic pathway* to delivering the 2035 Carbon Dioxide Removals target, essential for industrial decarbonisation and critical to the achievement of the UK's net zero commitment.



* For the purposes of this report, domestic Carbon Dioxide Removals refers to the input feedstock used to generate Carbon Dioxide Removals, in this case UK biogenic waste arisings

The UK Government is legally bound to deliver net zero across the whole economy by 2050.

'Hard to abate' emissions from key industries jeopardise net zero.

Residual emissions in 'hard to abate' sectors will need balancing through Carbon Dioxide Removals.

The Climate Change Committee calculates at least 45 million tonnes of Carbon Dioxide Removals per year are needed to meet any net zero pathway.

The 2035 Carbon Dioxide Removals targets are unachievable without Energy from Waste (EfW) with Carbon Capture and Storage (CCS).

UK EfW with CCS represents the only durable source of entirely domestically fuelled, engineered Carbon Dioxide Removals, up to 10.6 million tonnes per year, enough to balance all the emissions from Gatwick, Manchester, Stansted and Luton airports.

By 2035, the EfW sector could deliver up to 6 million tonnes of Carbon Dioxide Removals per year, more than enough to balance the fossil emissions of a clean power grid, rising to over 10 million tonnes per year by 2050; over 20% of the Climate Change Committee's minimum requirements.

The UK Government is legally bound to deliver net zero across the whole economy by 2050.



Chris Stark

Head of Mission Control:
Clean Power 2030,
former CEO Climate
Change Committee
March 2019

A transition to a near zero carbon economy is now technically achievable — credible scenarios now exist to achieve near-full decarbonisation in most sectors. This is genuine progress.

Electrification with zero carbon supply takes us much of the way — and there are now credible alternatives, like hydrogen, for those applications where that strategy won't work. And even in those sectors where emissions look set to continue, we can match emissions with greenhouse gas removals.



Chris Skidmore

Former Energy and
Clean Growth Minister
June 2019

The UK kick-started the Industrial Revolution, which was responsible for economic growth across the globe but also for increasing emissions. Today we're leading the world yet again in becoming the first major economy to pass new laws to reduce emissions to net zero by 2050 while remaining committed to growing the economy — putting clean growth at the heart of our modern Industrial Strategy. We're pioneering the way for other countries to follow in our footsteps driving prosperity by seizing the economic opportunities of becoming a greener economy.

‘Hard to abate’^① emissions from key industries jeopardise net zero^②.

1

‘Hard to abate’ emissions are typically defined as:

Ongoing emissions, regardless of date, which come from sectors considered to be very expensive or difficult to eliminate and typically include industry, agriculture and heavy-duty transport.

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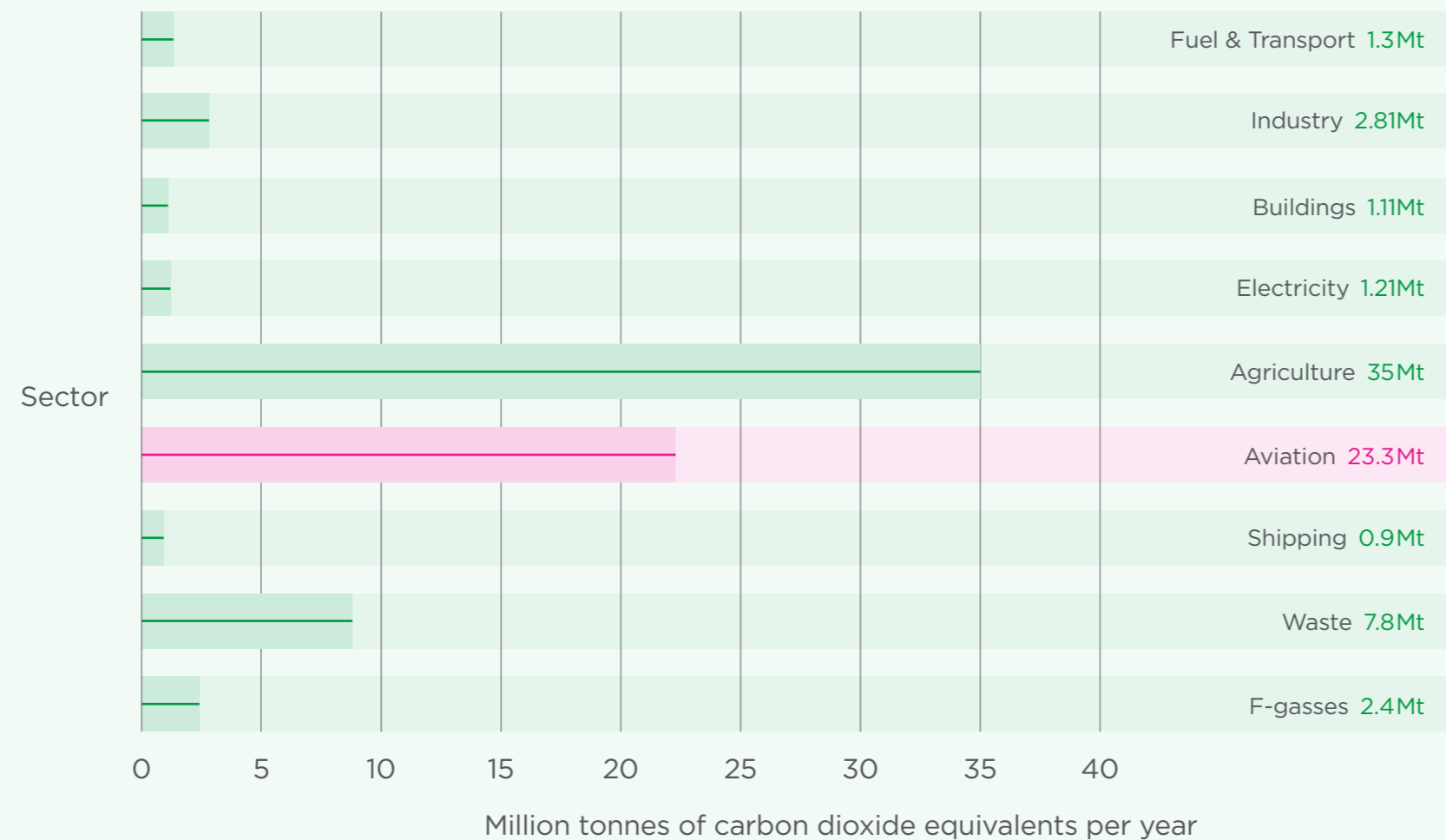
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The Climate Change Committee’s balanced pathway to achieve net zero estimates that, following the application of all the cost-effective emissions reductions, the economy continues to generate 76 million tonnes of carbon dioxide equivalent emissions a year, 16% of the 2023 levels.

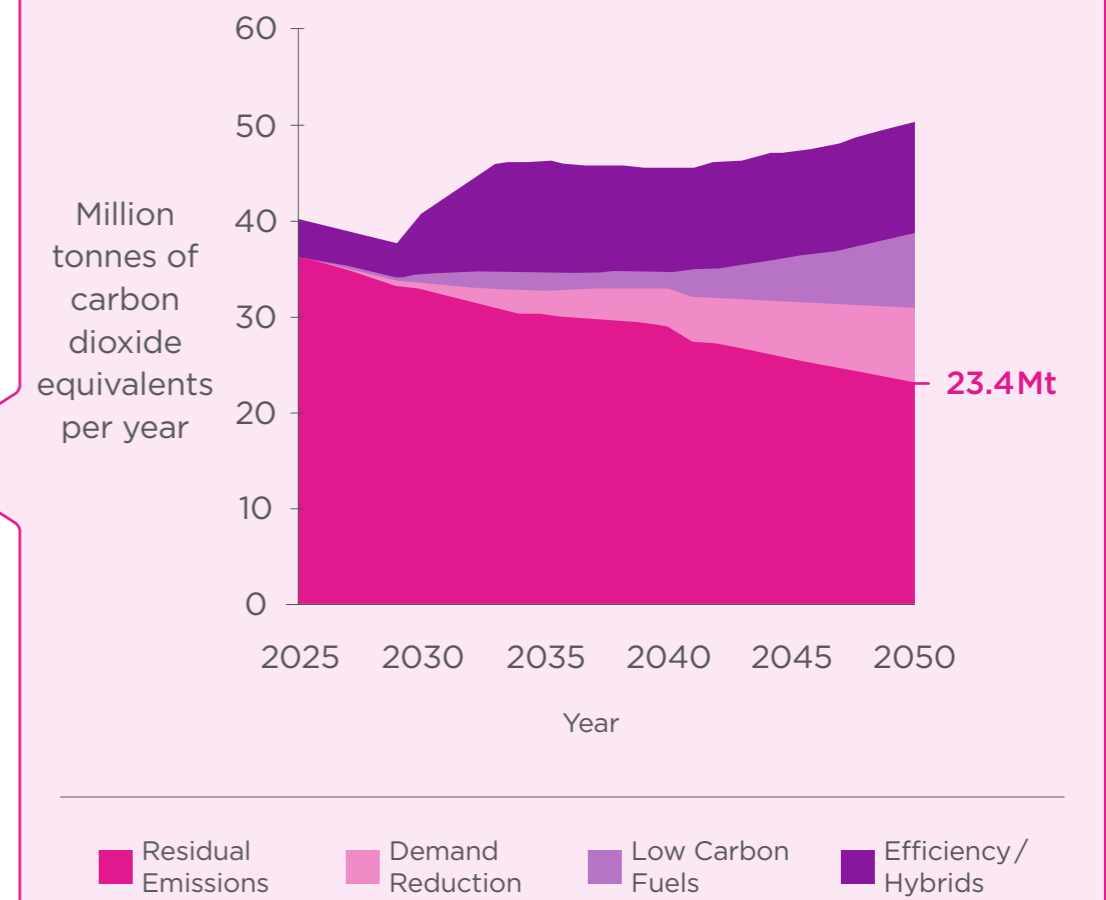
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2050 Residual Emissions by sector in the Climate Change Committee balanced pathway

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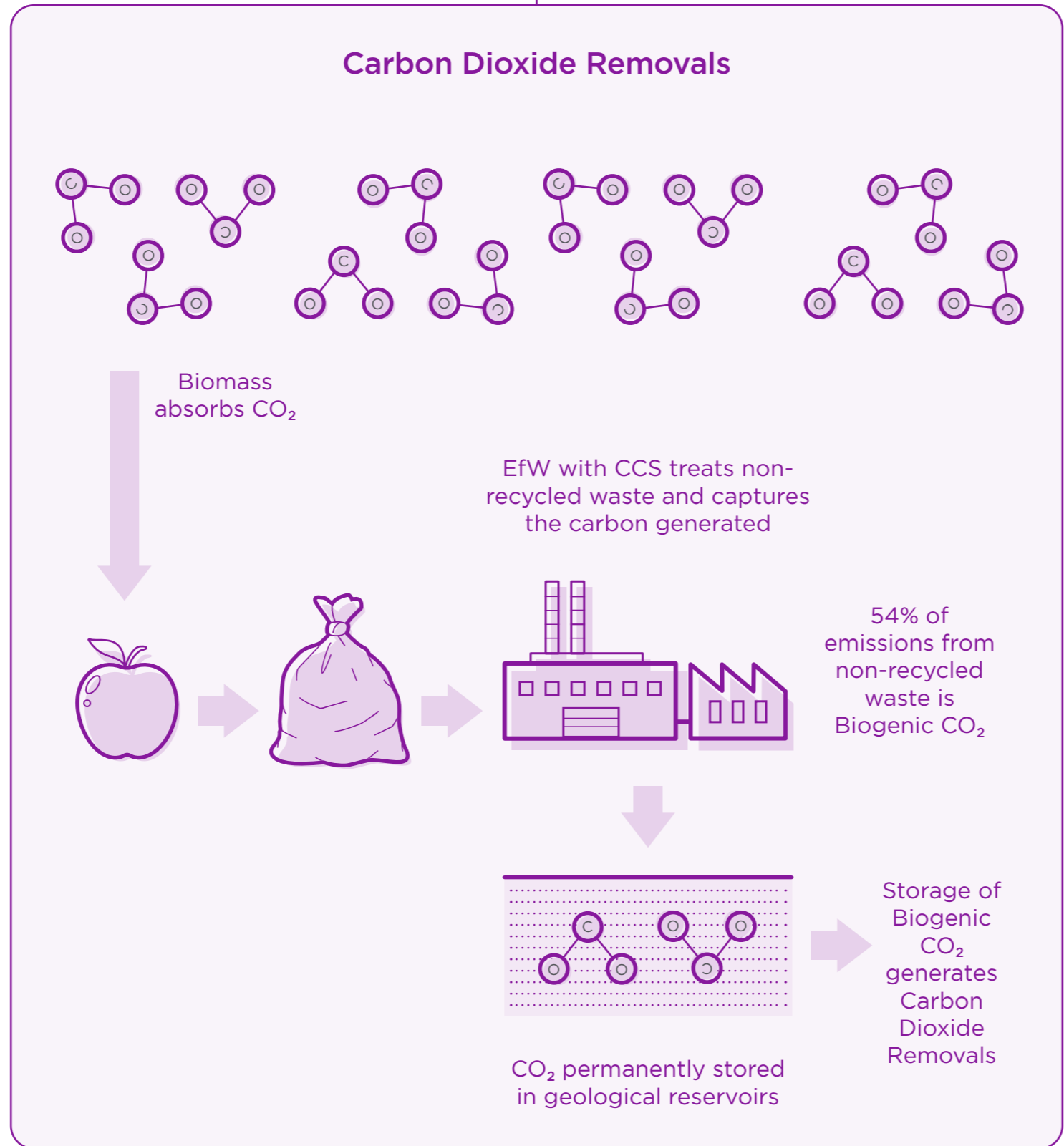


Routes for emissions reductions from the aviation sector identified by the Climate Change Committee

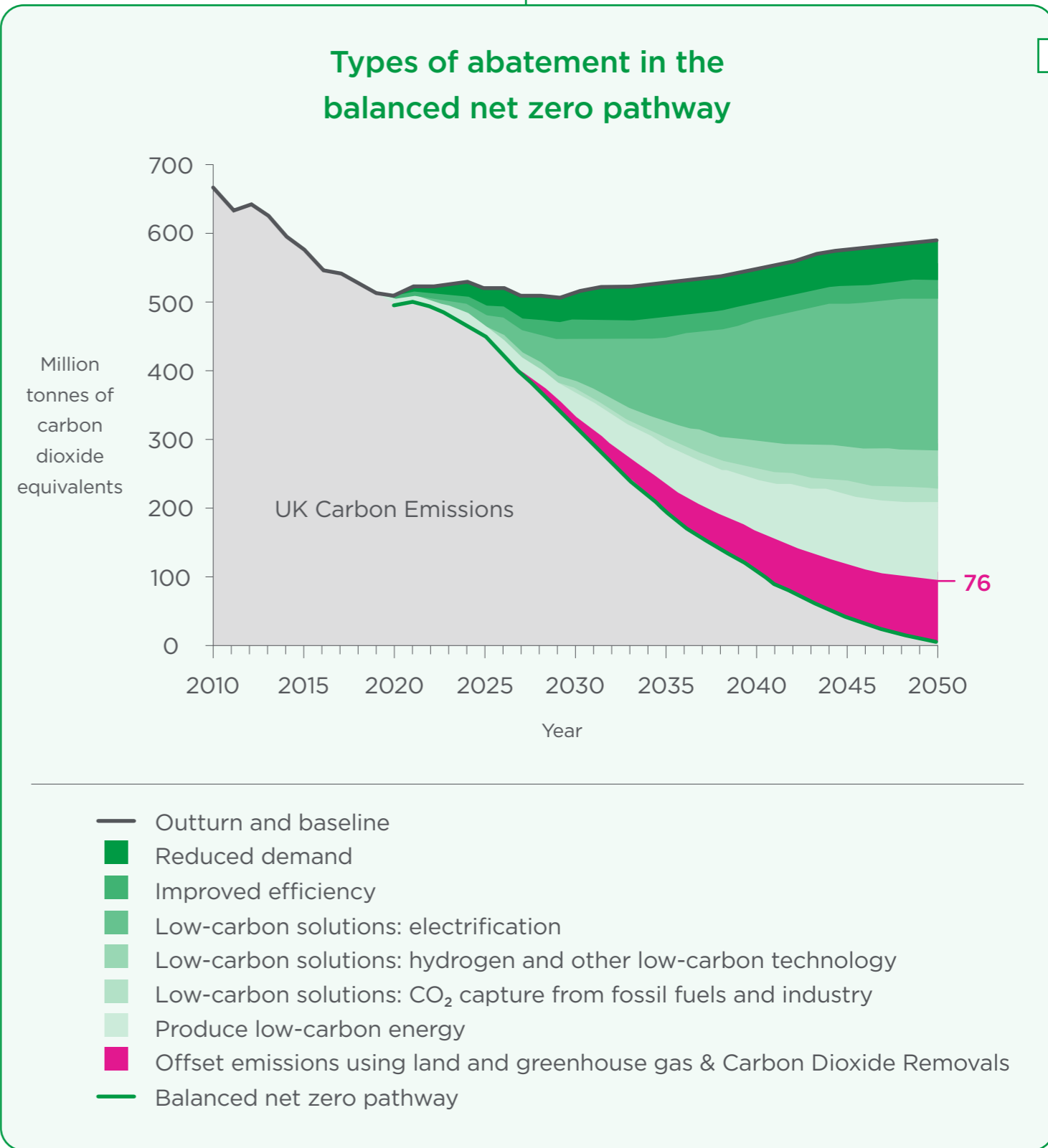


Residual emissions in 'hard to abate' sectors will need balancing through Carbon Dioxide Removals ① to achieve a net zero economy ②.

① The Intergovernmental Panel on Climate Change defines a Carbon Dioxide Removal as:
Anthropogenic activities removing carbon dioxide from the atmosphere and durably storing it in geological, terrestrial, or ocean reservoirs, or in products.



② Getting to net zero requires **76 million tonnes of Carbon Dioxide Removals per year** in the Climate Change Committee's balanced pathway.

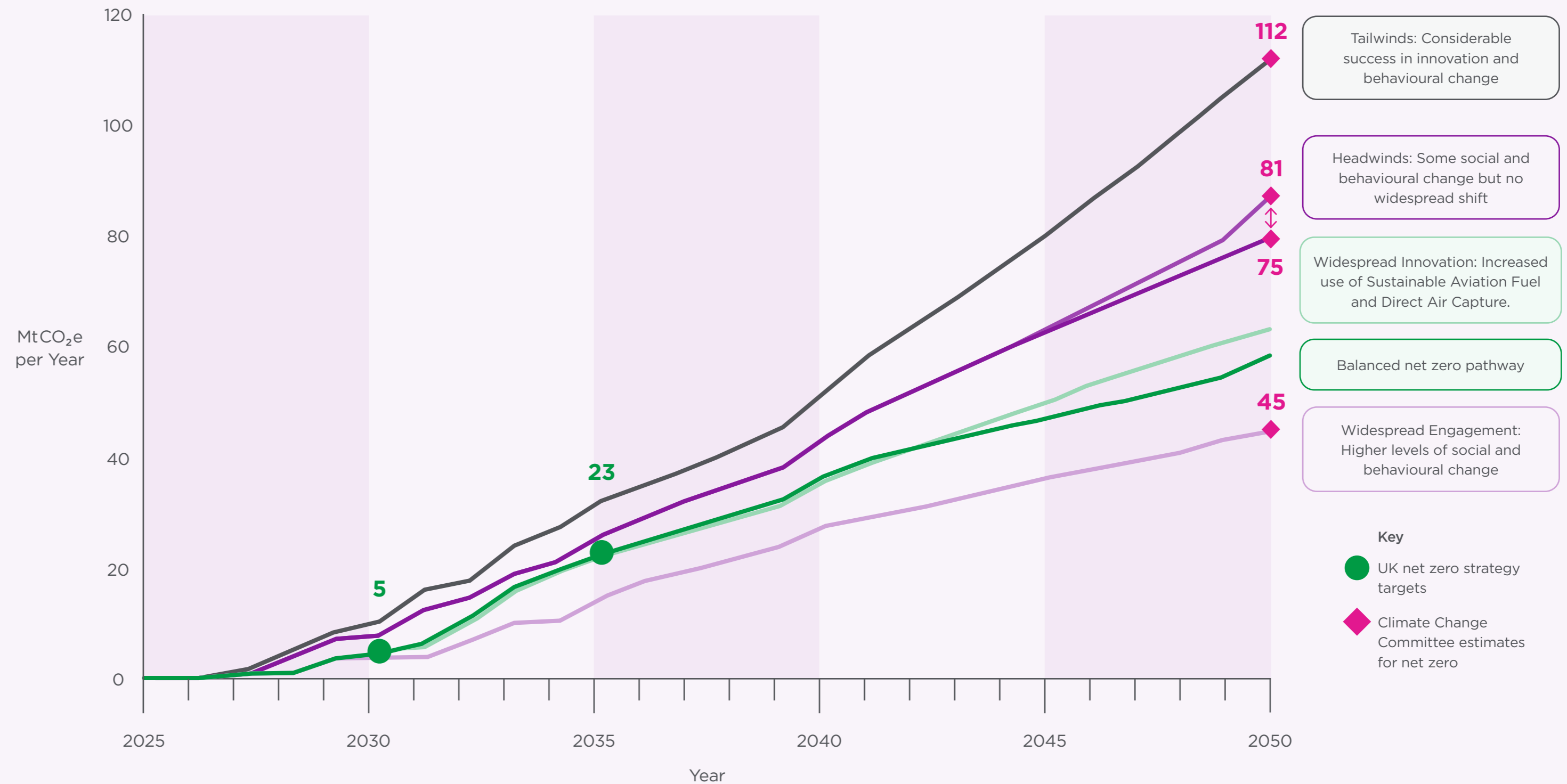


The Climate Change Committee calculates at least 45 million tonnes of Carbon Dioxide Removals a year are needed to meet any net zero pathway ①.

①

The Climate Change Committee has run five different net zero scenarios requiring between 45 and 112 million tonnes of Carbon Dioxide Removals per year in 2050.

Climate Change Committee's requirement for Carbon Dioxide Removals under different scenarios



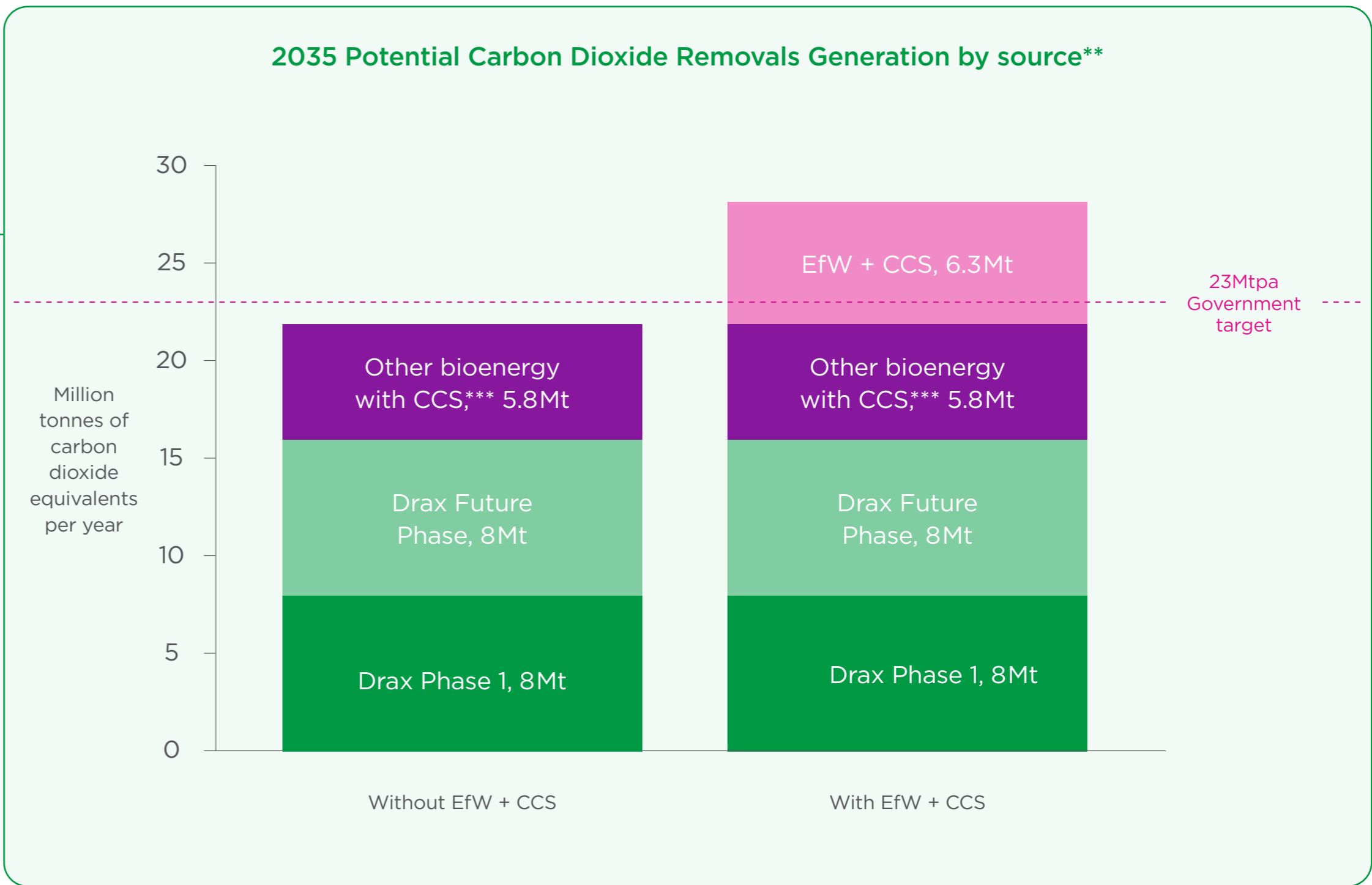
The UK Government 2035 Carbon Dioxide Removals targets (23 million tonnes per year 1) are unachievable without EfW with CCS 2.

①

In December 2023, the Government confirmed a Carbon Dioxide Removals* target stating:
Even with all our efforts to decarbonise, some residual emissions from hard to decarbonise sectors will remain, for which negative emissions will be needed... [with] an ambition to deploy at least 5 million tonnes per annum (Mtpa) of engineered Carbon Dioxide Removals by 2030 rising to up to 23Mtpa by 2035.

②

In 2021, the then Department for Business, Energy and Industrial Strategy published an ambition to deploy 23 million tonnes a year of Carbon Dioxide Removals by 2035. This was later confirmed in the 2023 Carbon Budget Delivery Plan.



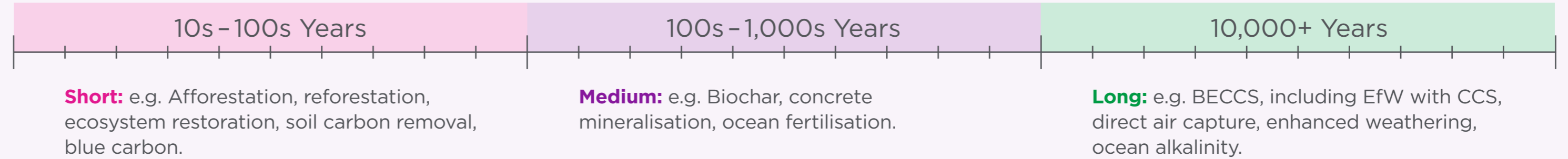
* For the sake of clarity the Government target is for Greenhouse Gas Removals of which Carbon Dioxide Removals are the principal tool.

** Other removal technologies such as biochar, carbon-negative cement and enhanced weathering have been excluded from the analysis as they are deemed speculative options requiring further research and development according to the Climate Change Committee.

*** Other bioenergy with CCS includes biomass power, biogas upgrading and biofuels plants and could produce 5.8M Carbon Dioxide Removals per year by 2035.

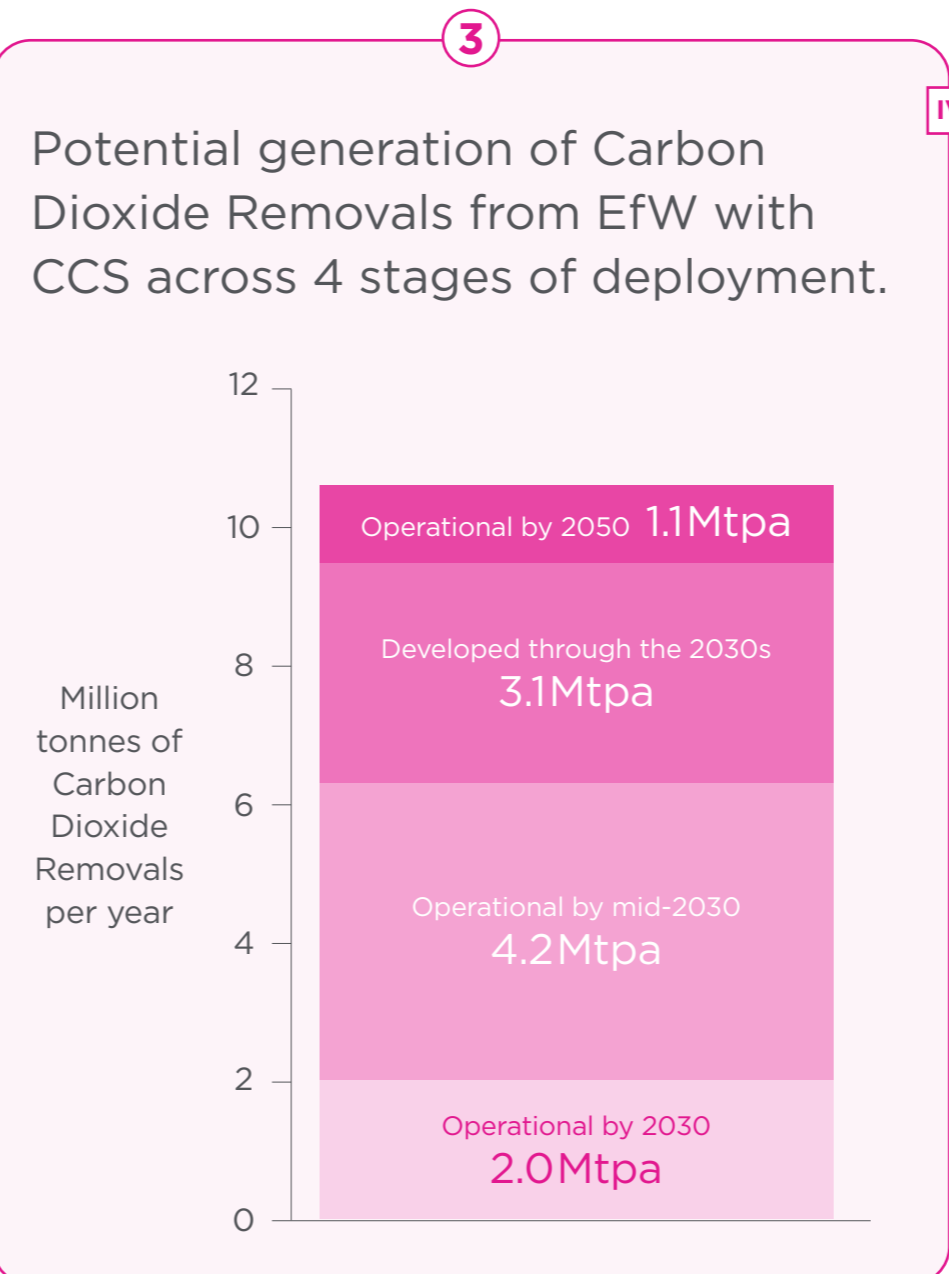
UK EfW with CCS represents the only durable ① source of entirely domestically fuelled Carbon Dioxide Removals ②, up to 10.6 million tonnes per year ③, enough to balance the emissions from Gatwick, Manchester, Stansted and Luton airports combined ④.

① Carbon Dioxide Removals have a range of longevity over which the carbon is locked out of the atmosphere. Carbon Dioxide Removals from EfW are classified as among the longest enduring.



② As the UK is a net exporter of waste the Carbon Dioxide Removals arising from the biogenic fraction are entirely domestically generated.

Source	Domestically Fuelled	Million tonnes a year Carbon Dioxide Reductions by 2050
Bioenergy CCS: Power (e.g. Drax)	No	38.7
Bioenergy CCS: Hydrogen	Partial	23.0
Bioenergy CCS: EfW	Yes	10.1-10.6*
Bioenergy CCS: Biofuels	Partial	9.8
Bioenergy CCS: Manufacture and Construction	Unknown	4.3
Bioenergy CCS: Biomethane	Partial	0.6
Direct Air Capture	Yes	0.0

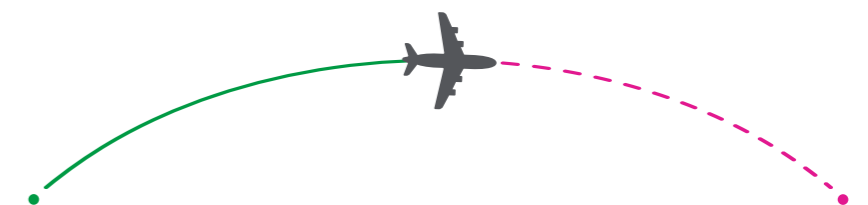


④ Emissions data (scope 1, 2 and 3) for largest UK exports excluding Heathrow. Scope 3 emissions for airports include take-off, cruise and landing for all departure flights.

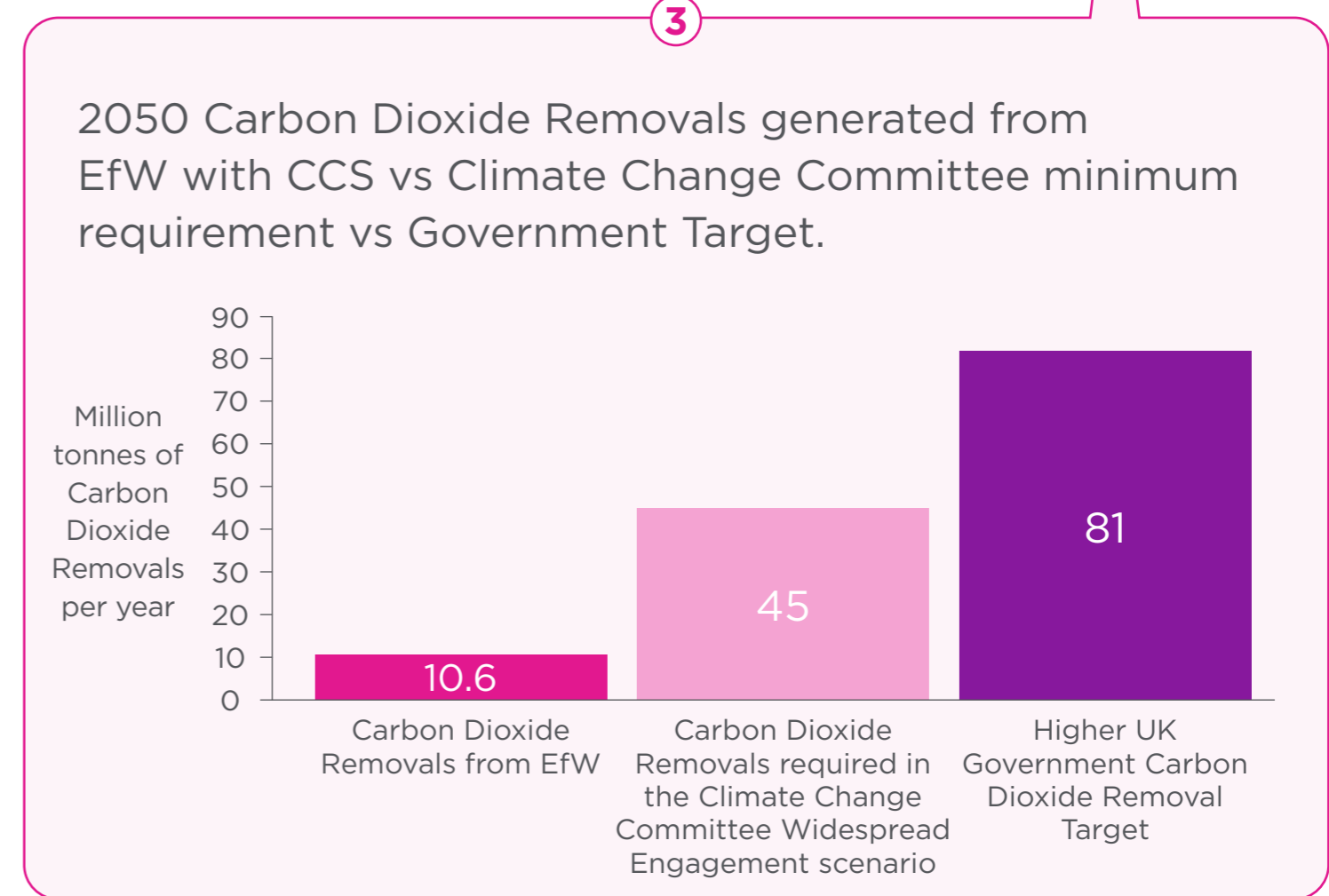
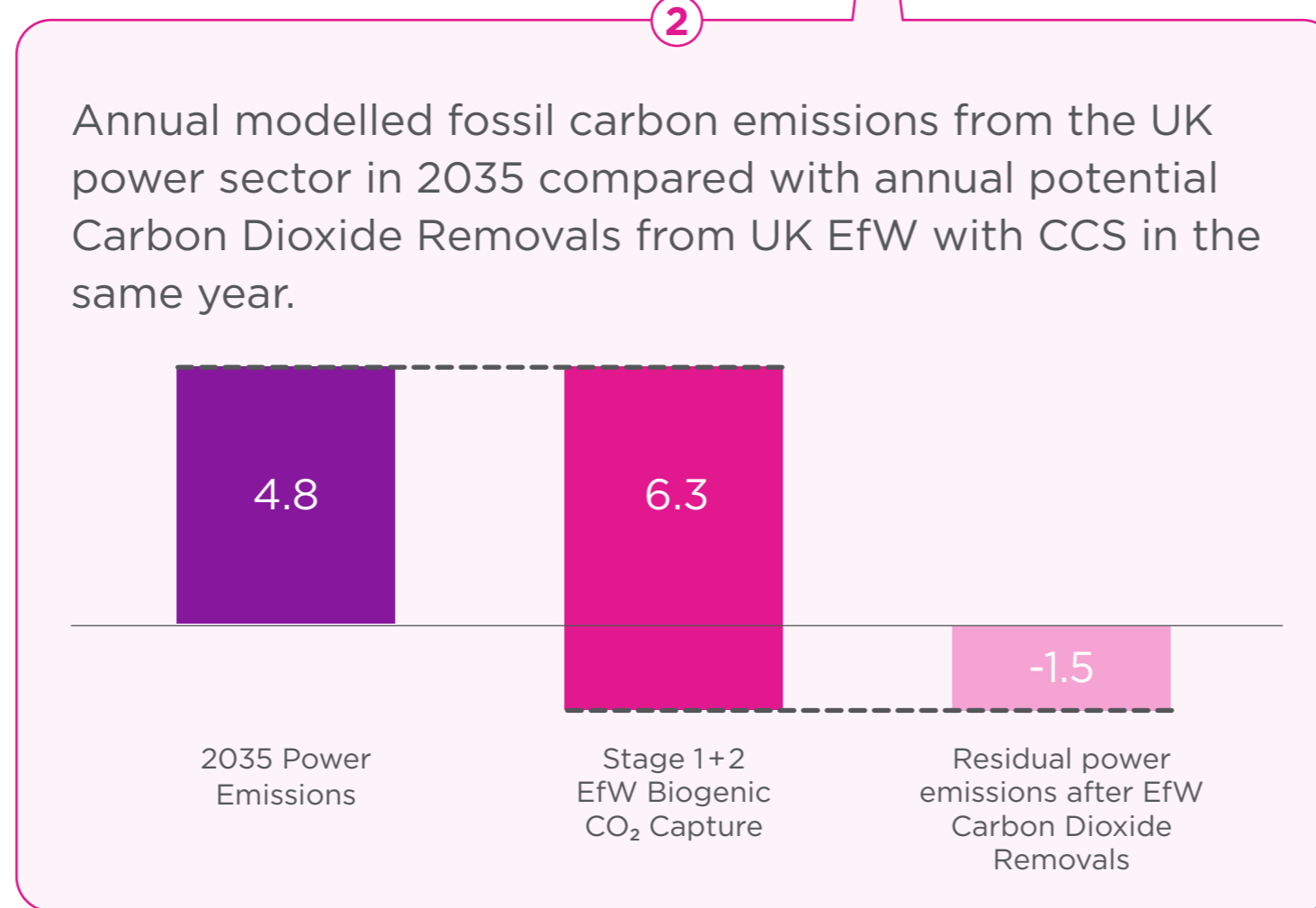
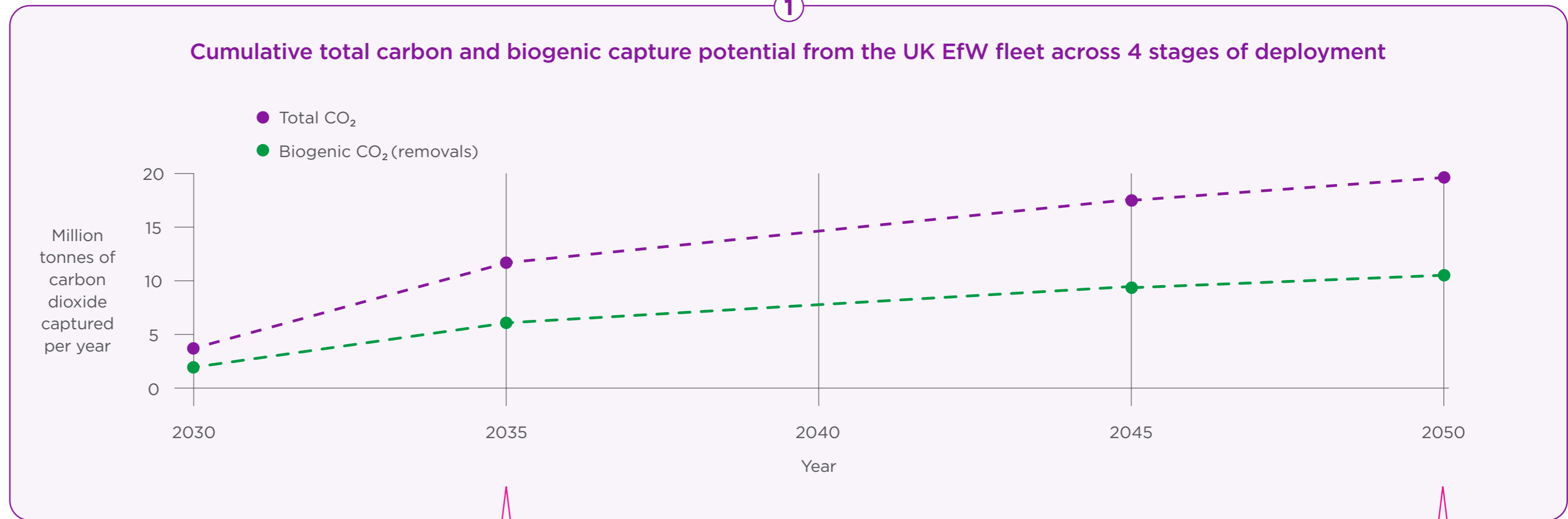
Airport	Emissions (Million tonnes carbon dioxide)**	Year
Gatwick	3.9	2023
Manchester	3.2	FY23/24
Stansted	2.4	FY23/24
Luton	1.4	2023
Total	10.3	

* The Climate Change Committee estimate this figure as 10.1 million tonnes a year. We have assumed a range of 10.6 million tonnes a year for consistency with ERM analysis

** Includes existing offsets

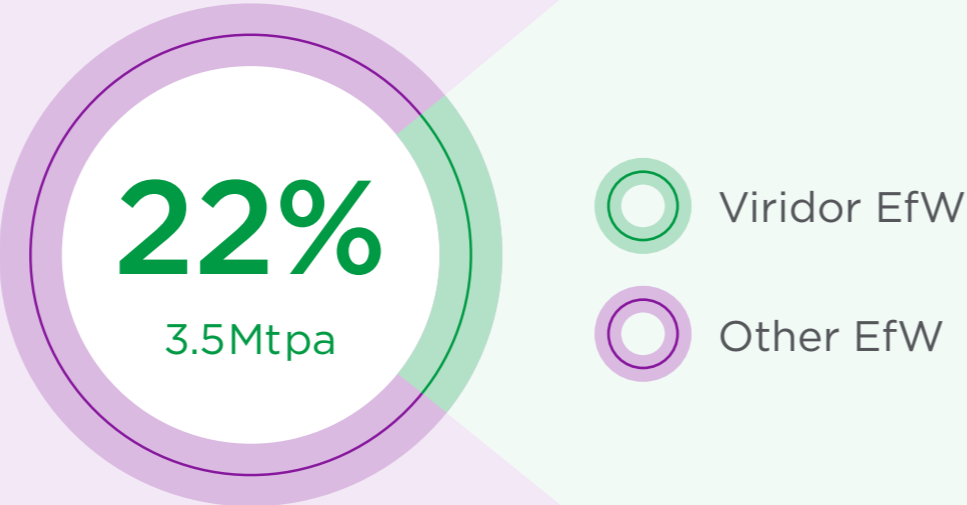


By 2035, the EfW sector could deliver up to 6.3 million Carbon Dioxide Removals a year^①, more than enough to balance the fossil emissions of a clean power grid^②, rising to over 10 million Carbon Dioxide Removals a year by 2050; over 20% of the Climate Change Committee's minimum requirements^③.



Viridor is the market leader in Energy from Waste, safely processing more than 3 million tonnes of non-recycled waste per year.

Total residual waste processed at UK EfW 2023



Viridor Energy manages a growing fleet of 12 EfWs



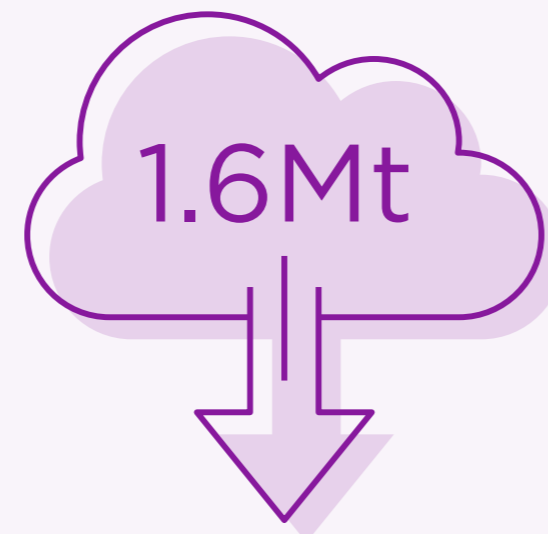
Viridor was the first UK Waste Management company to commit to carbon neutral by 2040 and climate positive by 2045.

In May 2021, Viridor published its commitment to:

Fight against the climate crisis by becoming the first UK net negative emissions waste company.

This includes specific targets of:

Capturing at least



of carbon dioxide per year by 2040 to achieve carbon neutrality across core emissions (scopes 1 & 2).



To become a climate positive waste* and recycling company by 2045.

* Climate positive is defined for us as capturing and storing more CO₂ than the total scope 1 and 2 fossil carbon emissions of the business

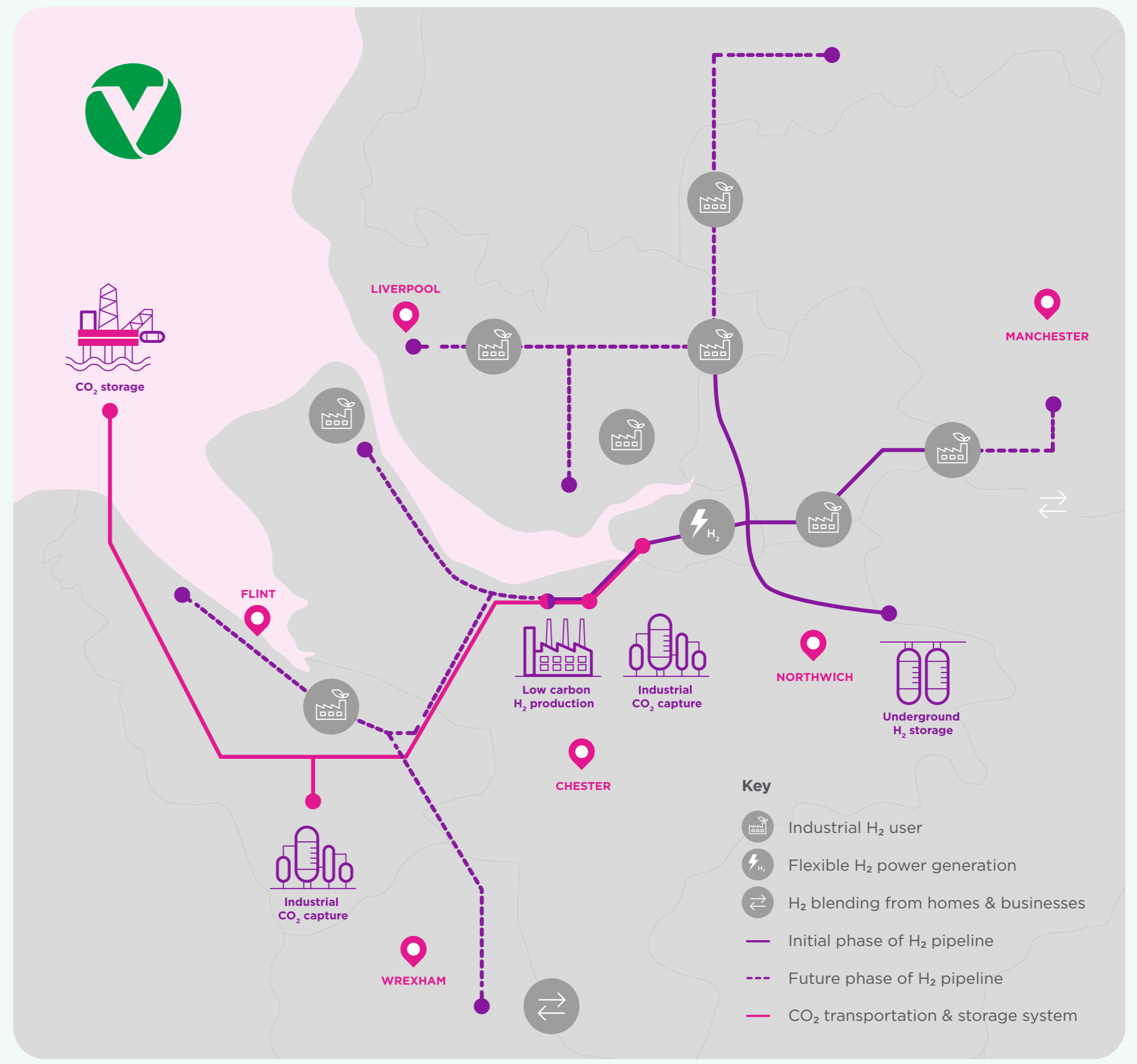
Viridor is on track developing the largest CCS implementation for an EfW plant in the UK ① in collaboration with DESNZ as part of the HyNet cluster ②.

①

2021	AUG	Viridor commissioned report by Eunomia sets out the scale of the opportunity for carbon capture across the UK EfW fleet.
		Viridor joins HyNet cluster.
	NOV	Viridor led government engagement results in inclusion of EfW within the carbon capture business model paving the way for carbon capture development.
		HyNet selected as track 1 carbon capture cluster.
2022	JAN	Track 1 Phase 2 (emitter) bid submitted.
	AUG	Project longlisted by DESNZ for due diligence.
		Runcorn CCS project passes to second stage of the government's Industrial Carbon Capture sequencing process.
2023	MAR	Runcorn CCS project shortlisted for the third stage of the government's Industrial Carbon Capture sequencing process.
	APR	Viridor Runcorn CCS project shortlisted for bilateral negotiations.
2024	MAR	Viridor agrees a Deal in the Round (Statement of Principles) with DESNZ.
	APR	Viridor Awards Engineering Design contract to Technip Energies/Shell.
	MAY	Agreement with government on Runcorn CCS project business model.
PRESENT		Engineering Design continues at pace.

②

Viridor is one of two EfW projects in the final stages of the CCS programme shortlisted from a total of 51 projects.

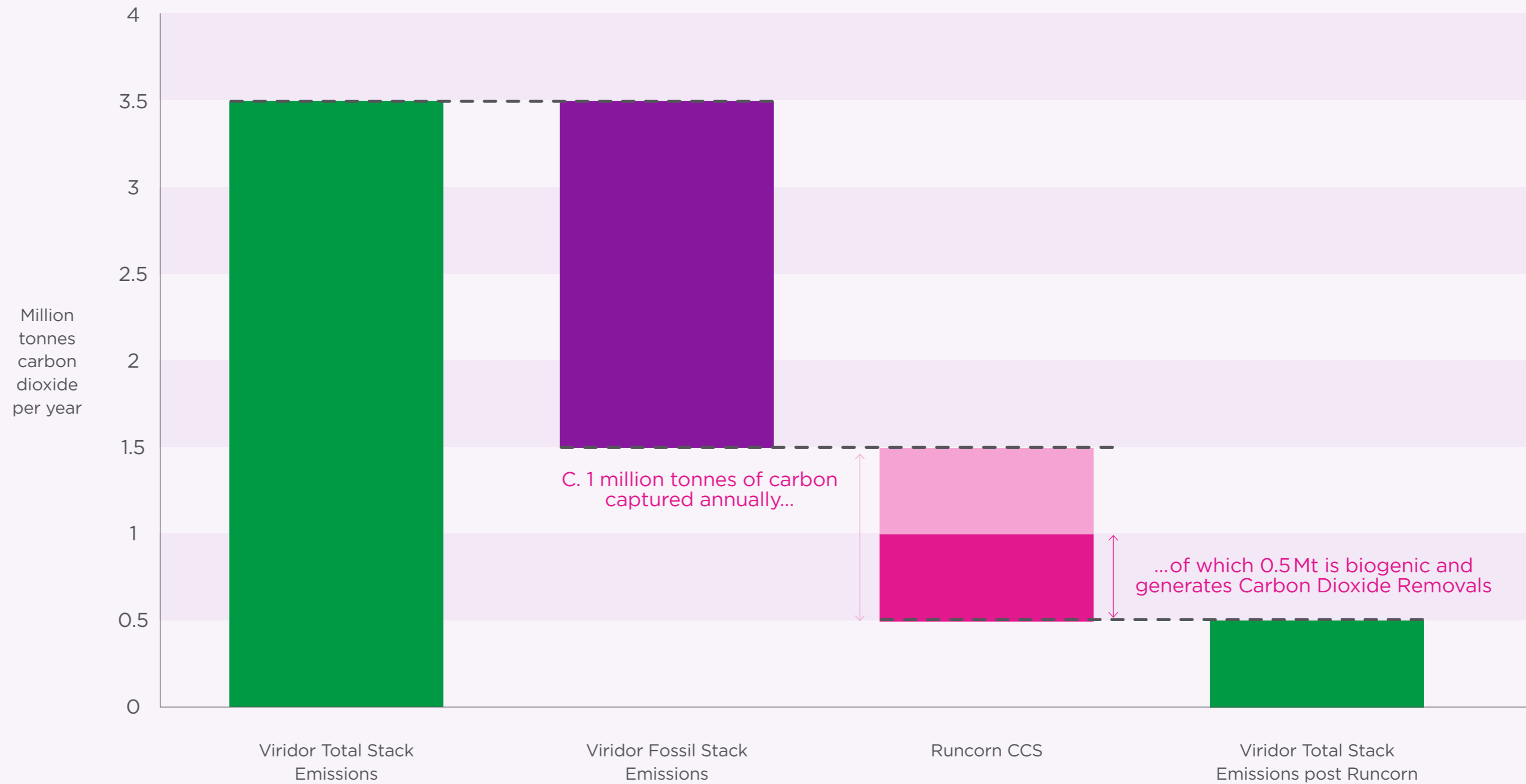


The Runcorn CCS plant will capture c.1 million tonnes of carbon dioxide a year generating over 0.5 million Carbon Dioxide Removals per year; it alone will reduce Viridor's stack emissions by 64% ①.

①

Viridor 2024 stack* Carbon Dioxide Emissions of 1.5 million tonnes compared to stack emissions post Runcorn CCS development with c.0.5 million tonnes of Carbon Dioxide Removals generated.

Viridor Total Stack Emissions pre and post Runcorn CCS Development

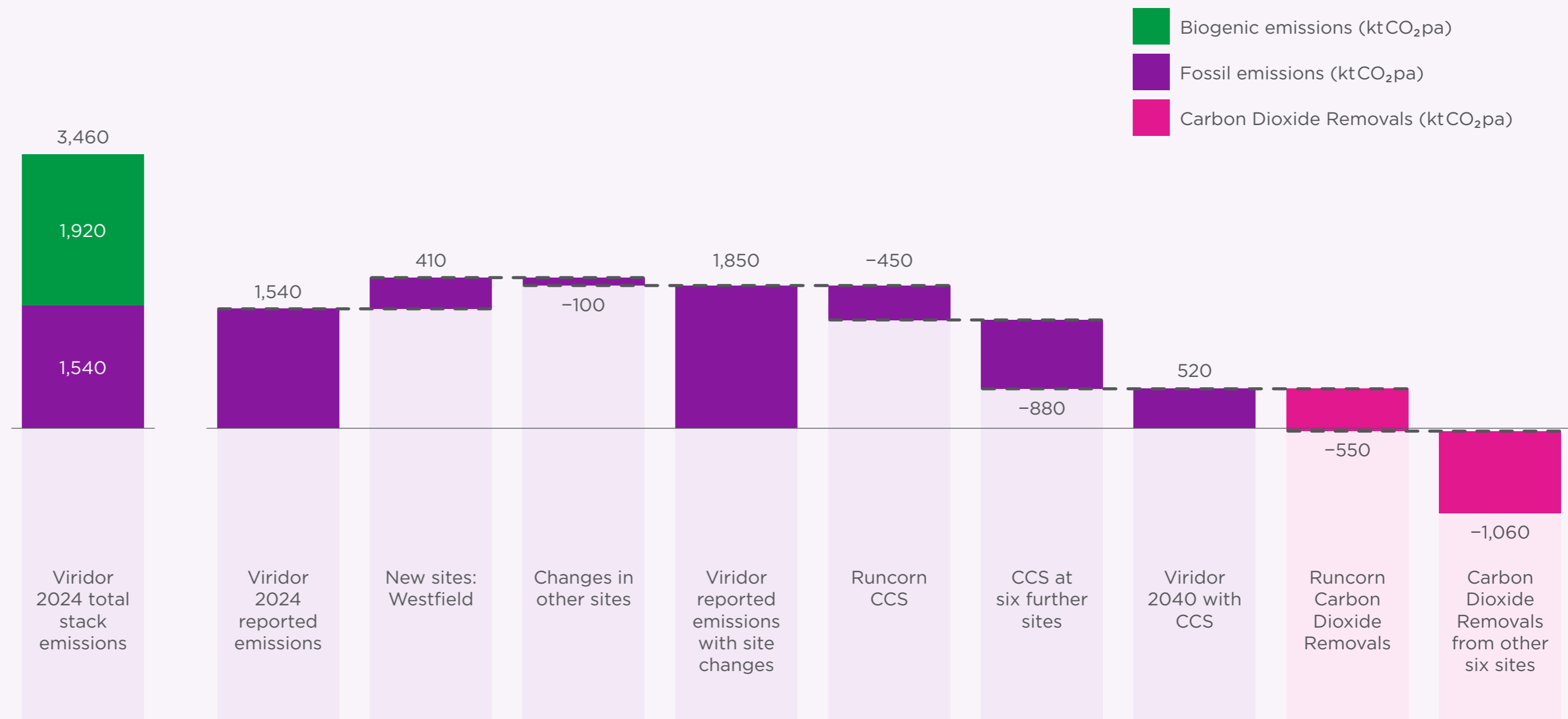


* Stack emissions constitute 99.7% of all Viridor scope 1 and 2 emissions.

Viridor has developed a major CCS investment programme spanning the next two decades to go beyond net zero and achieve a climate positive business producing over a million tonnes of Carbon Dioxide Removals each year.

Viridor can reach carbon neutrality in 2040 and realise c.1Mtpa of Carbon Dioxide Removals sales by rolling out CCS at seven sites (including Runcorn).

Viridor EfW fleet Scope 1 CO₂ emissions and savings (ktpa)^{***}



* Does not include non-stack Scope 1 (c.10ktpa), Scope 2 (c.2ktpa) or Scope 3 (e.g well-to-wheel emissions for waste transport, or transport or storage emissions for CO₂).

** Assumes 95% capture rate and 95% availability of CCS, and no change to waste volumes or biogenic share by site.

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Department for Business, Energy and Industrial Strategy (2021), 'Net Zero Strategy', p.184

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Department for Energy Security and Net Zero (2023), 'Carbon Budget Delivery Plan', Annex B, Table 5, Quantified Policies Table — Policy 191

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Analysis provided by BCG for Viridor