



The path to 'Net Zero': monitoring the flight CO₂ emissions of the world's largest airlines

In cooperation with Impact on Sustainable Aviation

JULY 2025

EXECUTIVE SUMMARY

As the aviation finance market experiences significant changes in monitoring and reporting CO₂ emissions due to regulatory frameworks and industry initiatives, Cirium has launched a new Top 100 airline CO₂ emissions report, to help navigate the true emissions footprint of flights and aircraft.

The report presents a first-time view of Cirium's EmeraldSky emissions estimates for the world's largest airline operators by 2024 available seat kilometers (ASK) flown, benchmarked against 2019 performance. It plots the progress of the carriers towards their long-term goal of achieving net zero CO₂ emissions from aircraft operations.

At the top level, the 100 largest passenger airline operators flew just over 8.4 trillion ASKs in 2024, representing a just over 7.4% increase from 2019, but Cirium estimates overall CO₂ emitted was up just over 0.2% over the same period, to a little under 635m tonnes. Therefore, average CO₂/ASK fell by just over 6.7%, from 80.7g to 75.3g.

Cirium's analysis identified 18 operators that delivered both ASK growth and overall reductions in CO₂ emitted between 2019 and 2024, led by Iberia with emissions down almost 1.4% despite a capacity gain of more than 17%. Notably during this time period, the Spanish flag-carrier removed 16 four-engined Airbus A340s from its active fleet and replaced them with a similar number of latest-generation A350 twinjets.

2024 vs 2019:	% change ASKs	% change CO ₂	% pt. diff.*
Iberia	17.3%	-1.4%	18.7
Shanghai Airlines	6.3%	-9.4%	15.7
Xiamen Airlines	4.3%	-6.8%	11.1
Shandong Airlines	6.0%	-4.3%	10.4
China Eastern Airlines	6.2%	-3.4%	9.6
China Southern Airlines	3.7%	-5.4%	9.1
Singapore Airlines	5.8%	-3.2%	9.0
Shenzhen Airlines	7.0%	-1.9%	8.9
Capital Airlines	6.7%	-1.4%	8.1
Cebu Pacific	5.1%	-2.8%	7.9
Virgin Atlantic	1.3%	-6.6%	7.9
Alaska Airlines	5.6%	-1.9%	7.5
Air China	4.9%	-2.5%	7.4
TUI Airways	0.5%	-6.7%	7.2
TAP Air Portugal	2.1%	-5.0%	7.0
JetBlue	2.1%	-4.3%	6.5
American Airlines	5.0%	-1.2%	6.2
Saudia	5.0%	-0.9%	5.9

*Decoupling score (% change ASKs - % change CO₂)

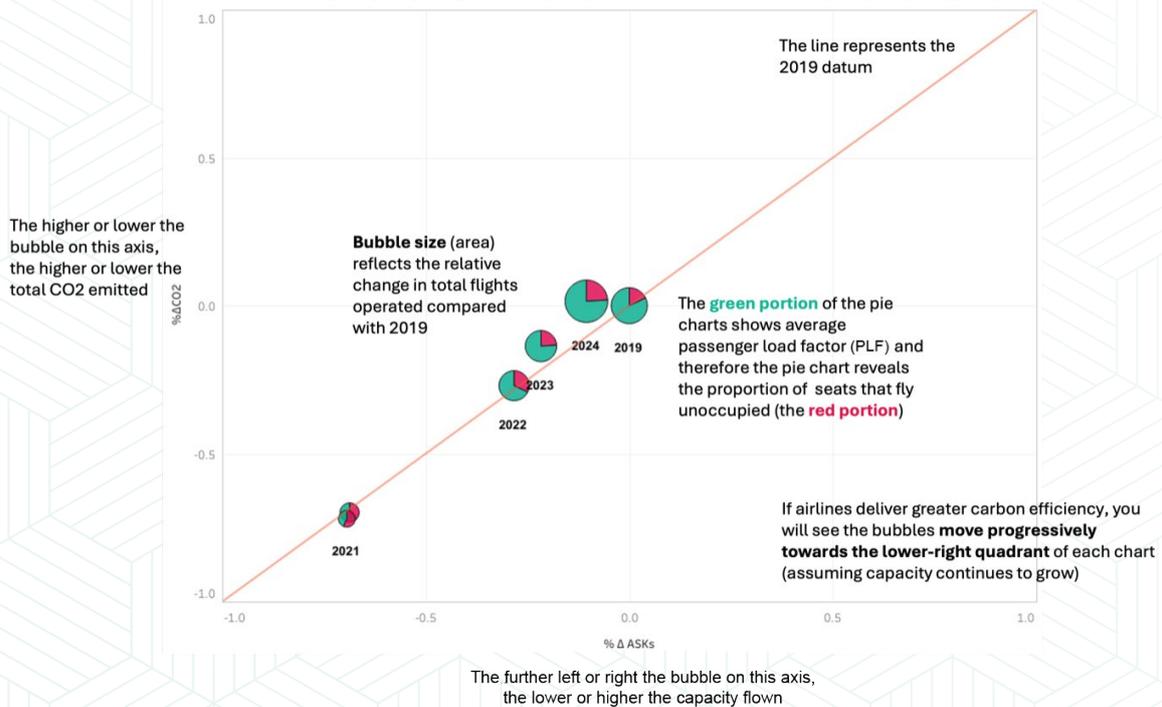
The report

Cirium has partnered with Impact on Sustainable Aviation e.V (IMPACT) to bring airline CO₂ emission insights to the finance community in aviation, providing an 'at a glance view' through individual charts. The partnership supports IMPACT's **milestone concept** to decarbonize aviation.

Each airline chart displays six 'bubbles' – one for each calendar year – positioned according to percentage change in total CO₂ emitted and ASKs flown compared with 2019.

These charts showcase the progress towards delivering ASKs with greater carbon efficiency, which if achieved would progressively push the bubbles shown in the charts towards the lower-right quadrant of each chart (assuming capacity continues to grow). This reflects the reduction of absolute CO₂ emissions; an effect that will become more pronounced with increased Sustainable Aviation Fuel (SAF) usage / technological carbon removal.

The bubble sizes meanwhile indicate whether capacity is being added through extra flights and/or average seat count increases, while the pie charts reveal the proportion of seats that fly unoccupied.



Interpreting the chart

Viewing the data by flown ASKs provides more accuracy as Cirium can calculate this with high precision, based on the known seat capacity of each aircraft and the great circle distance between airports for each tracked flight. Calculated revenue passenger kilometers (RPK) or revenue tonne kilometers (RTK) are less precise because payloads are not reported on a flight-by-flight basis.

The average PLF for each operator is displayed as Cirium's EmeraldSky methodology delivers increased flight-level emissions as passenger load increases, while CO₂ per RPK is reduced as flight-level emissions are divided between a greater number of passengers.

EmeraldSky methodology

Cirium's EmeraldSky calculates flown flight emissions within 99% accuracy, using proprietary data on the aircraft including age, engine type, winglets, tarmac time, load factor, and flight duration, combined with precise fuel and emissions models.

The EmeraldSky emissions estimates have been commended as the most accurate, independent, and standardised estimates available in the market and have been audited by EY and accredited by the Rocky Mountain Institute (RMI) as a qualified data provider to the Pegasus Guidelines. Full details of Cirium's methodology are available [here](#).

Impact on Sustainable Aviation e.V

Together with IMPACT, Cirium wants to chart a common path to sustainable aviation. IMPACT has forged three clear KPIs that are crucial to decarbonise the industry. The three KPIs include:

- Emissions footprint (total volume of CO₂ emitted by a carrier over a year)
- Emissions intensity (CO₂ needed to transport a standard capacity unit)
- Emissions decoupling (how closely emissions are linked to air traffic growth)

This report is one step towards monitoring and reporting on the progress of carriers in reducing CO₂ emissions of flights operated.

Criteria

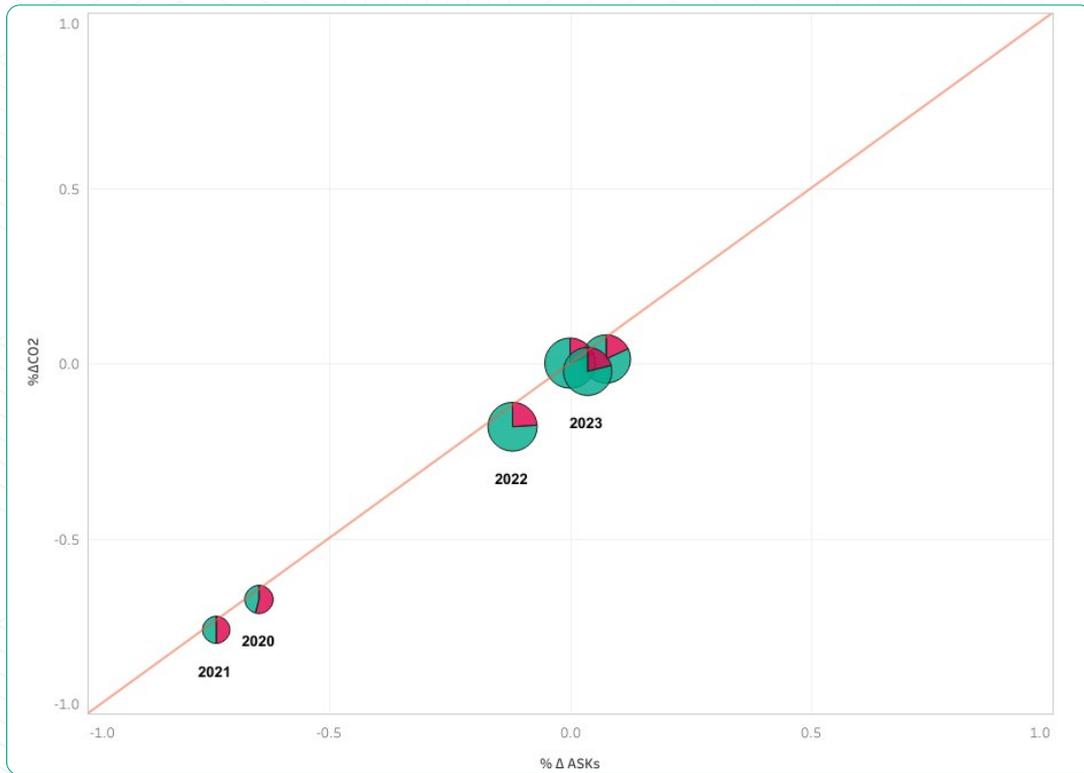
- Top 100 airline operators by 2024 available seat kilometers (ASK) flown benchmarked against 2019 performance. The report does not include Russian carriers.
- One chart 'bubble' represents one calendar year
- The 'bubbles' are plotted according to percentage change in total CO₂ emitted and ASKs flown
- The emissions estimates include CO₂ attributable to belly cargo
- Annual passenger load factors are based on averaged monthly airline-reported data where available. Otherwise estimated

Exceptions

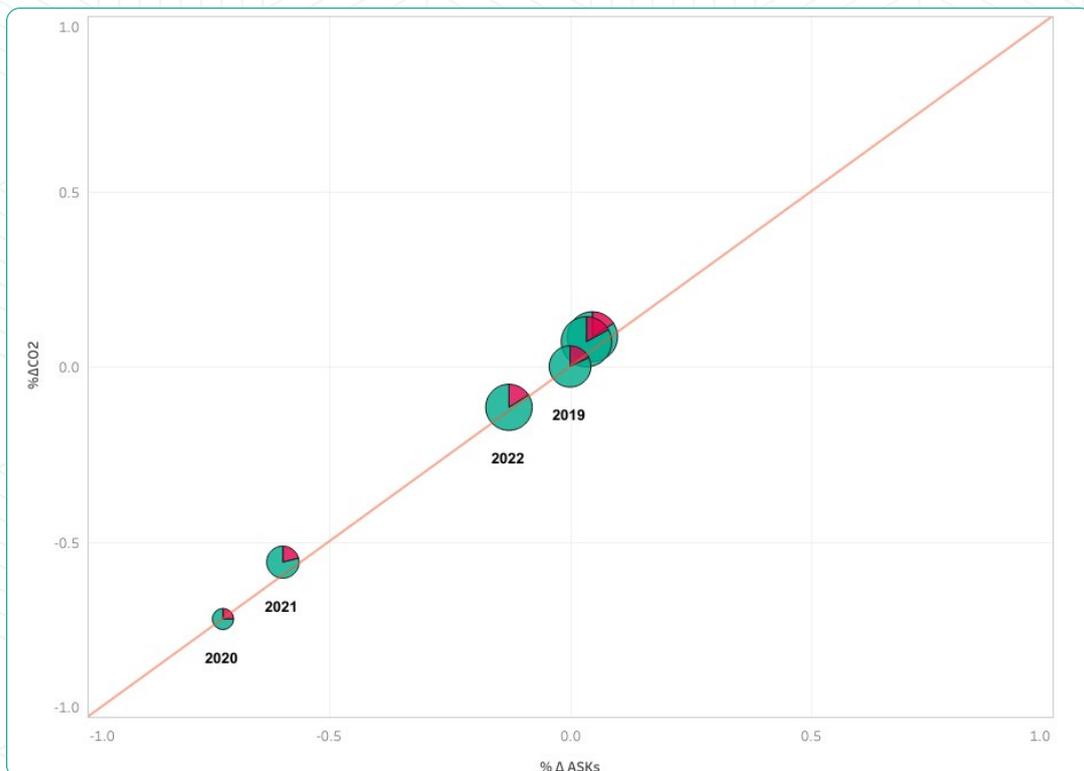
- ITA Airways launched operations in October 2021 and therefore no data was available for 2019 and 2020
- Wizz Air Malta hadn't started operations in 2019 and therefore there is no datum data available

CONTENTS

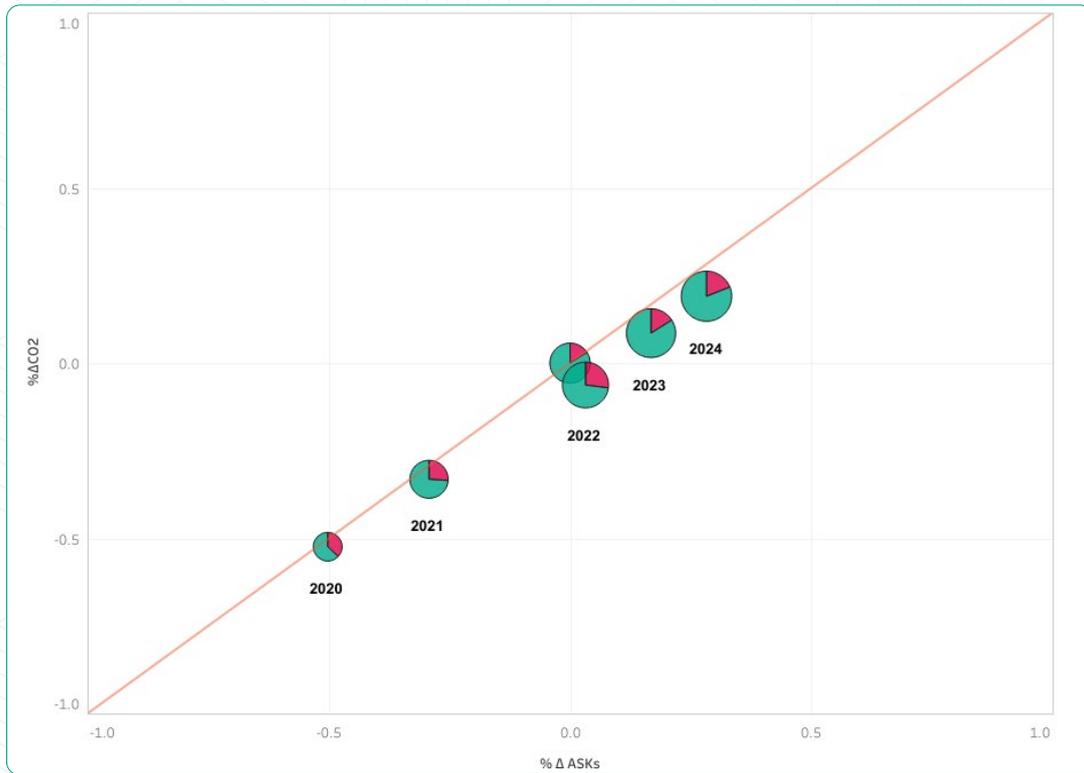
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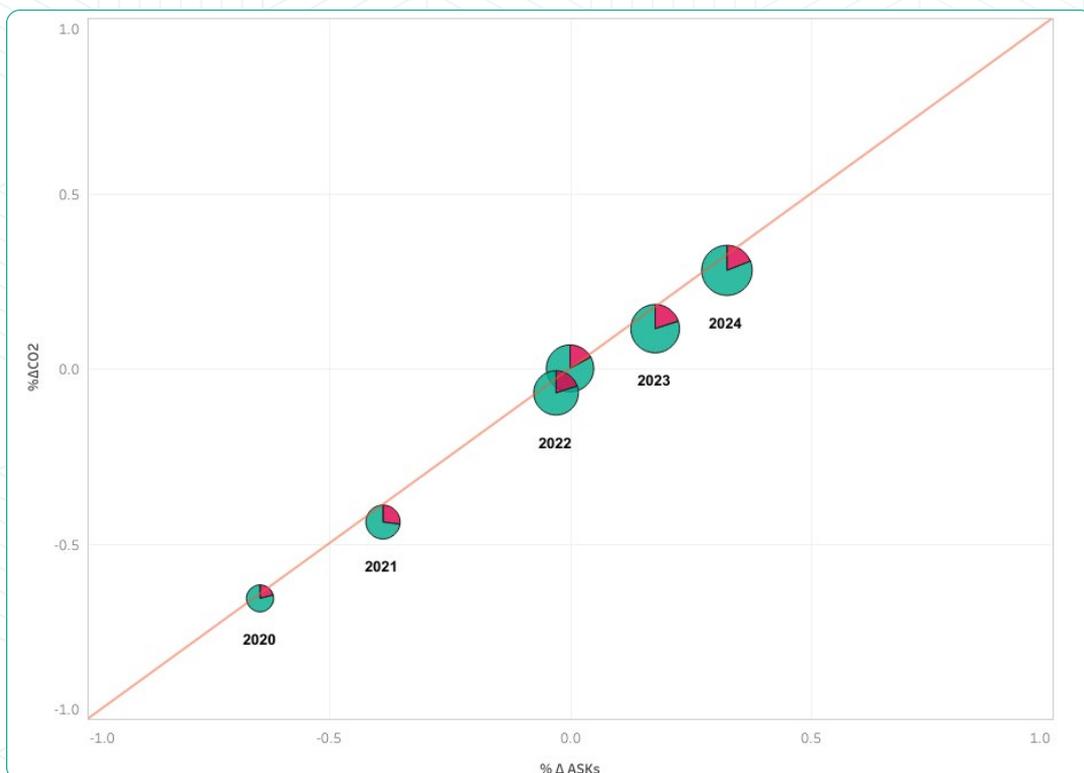
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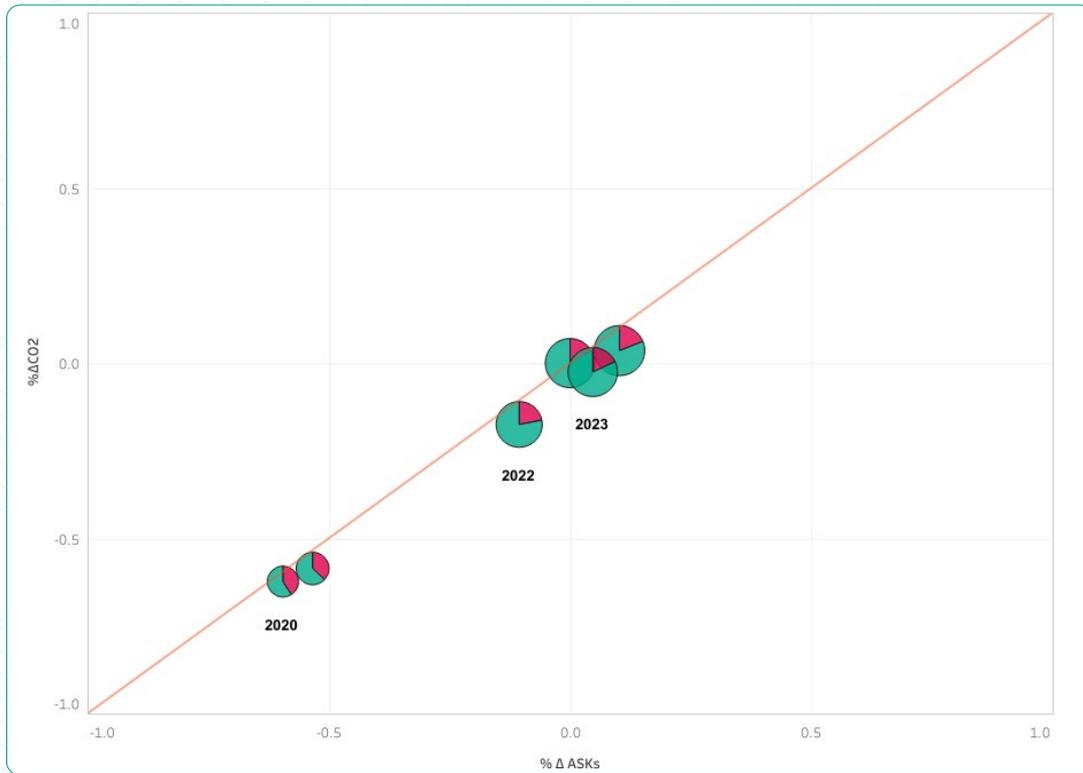
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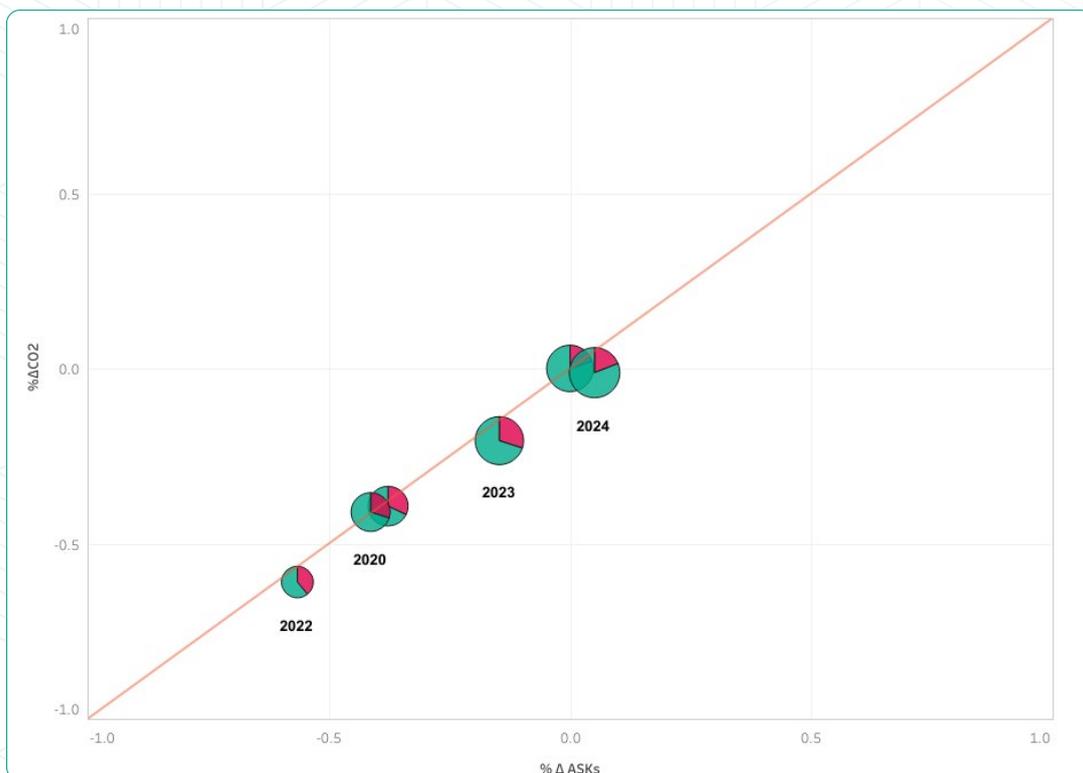
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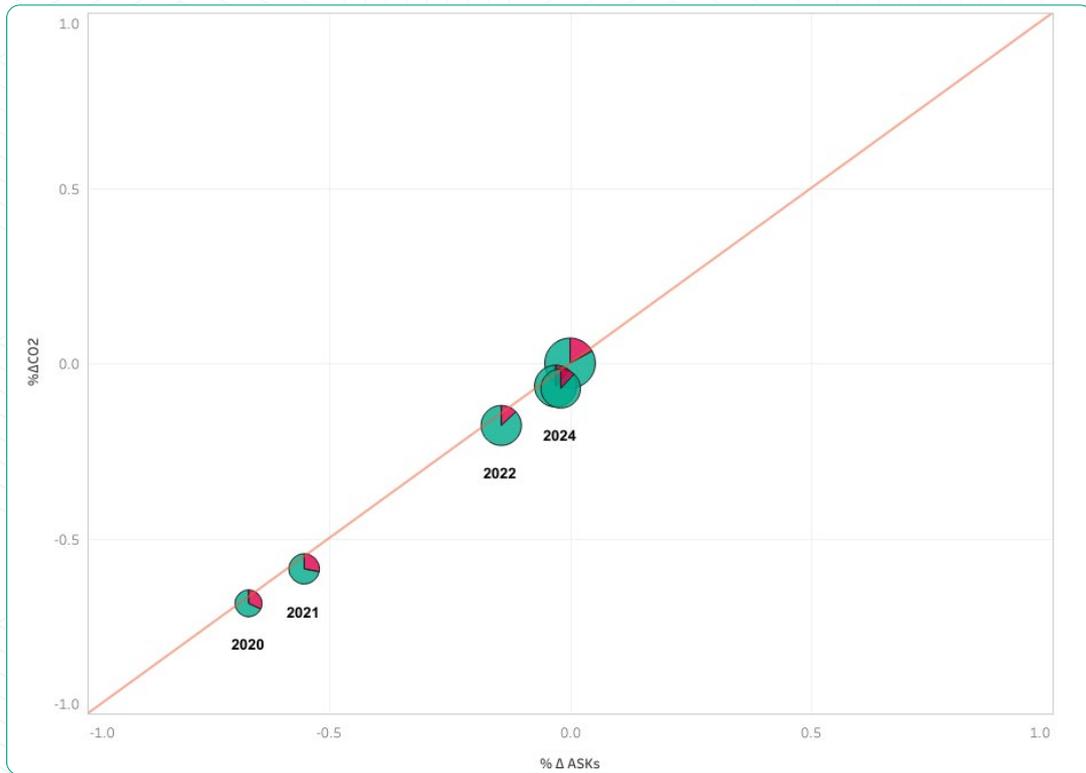
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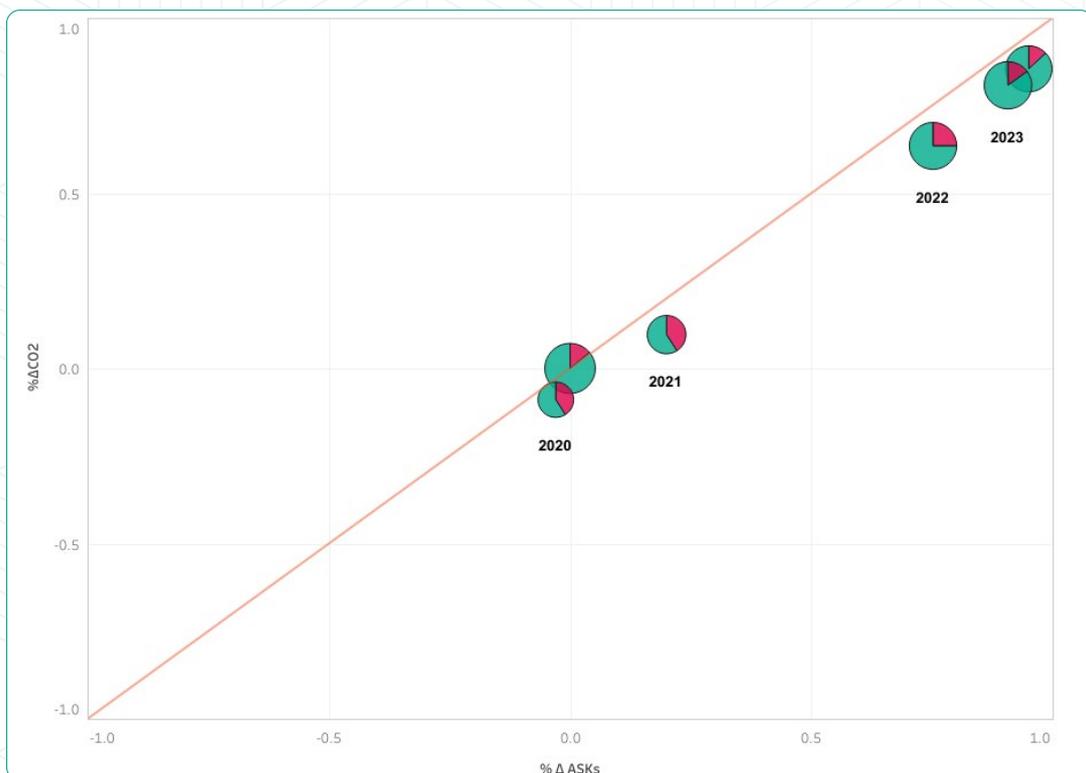
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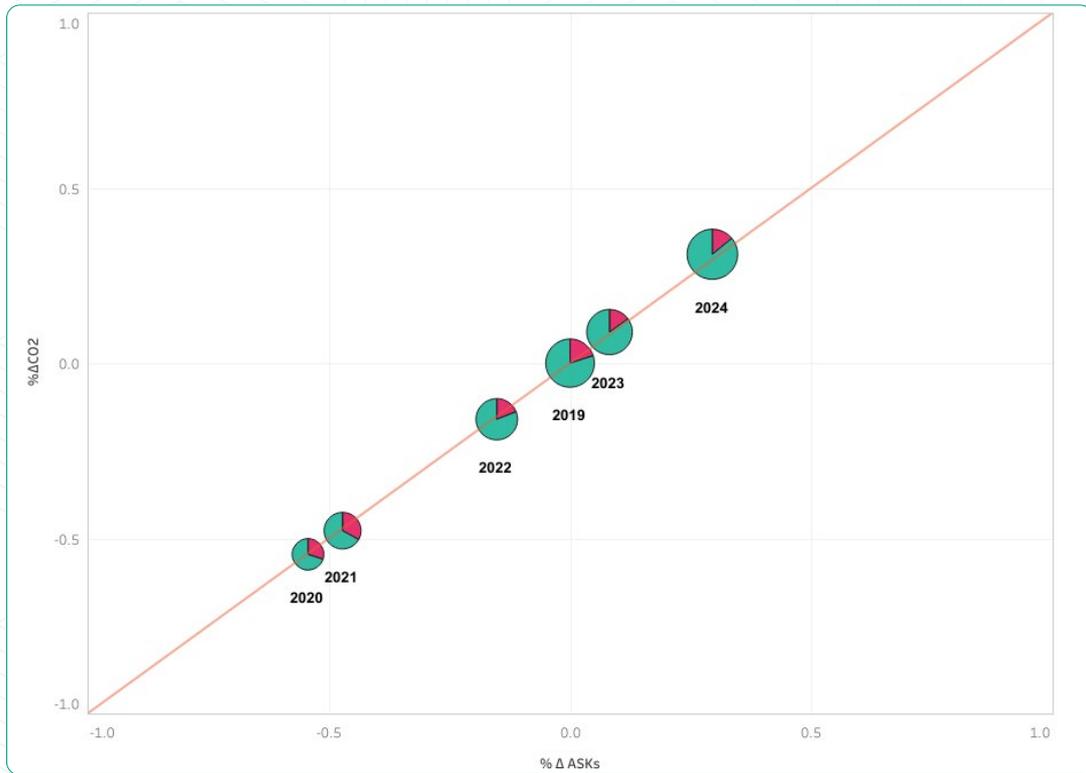
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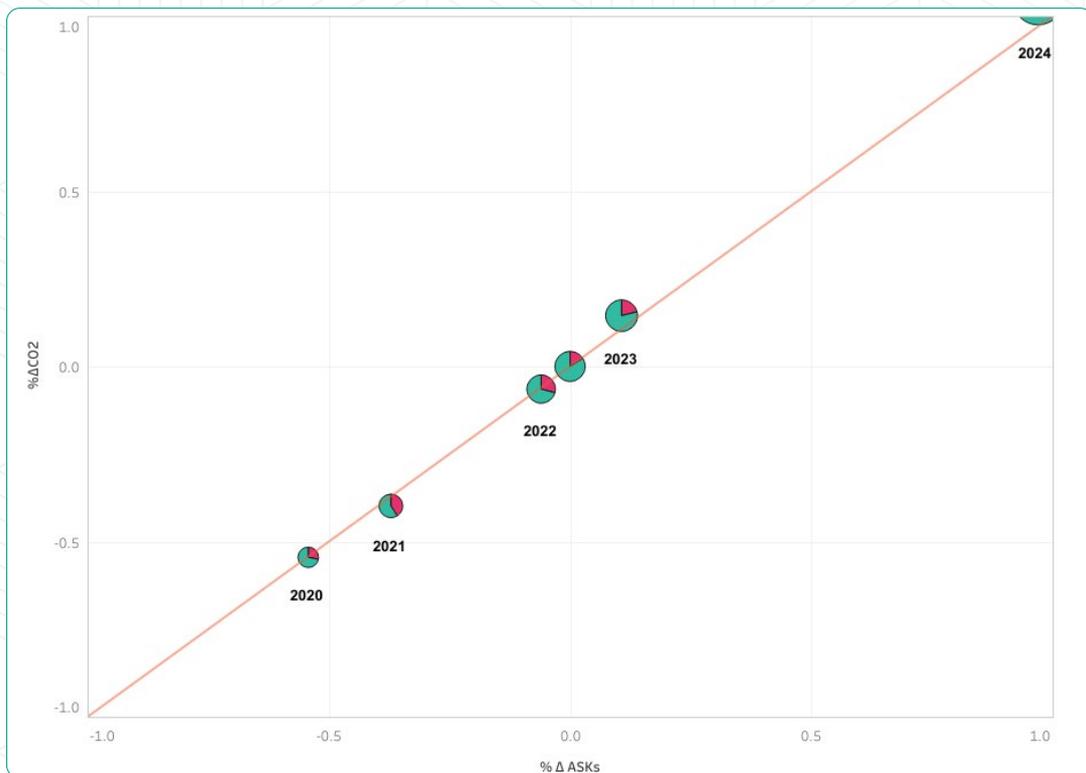
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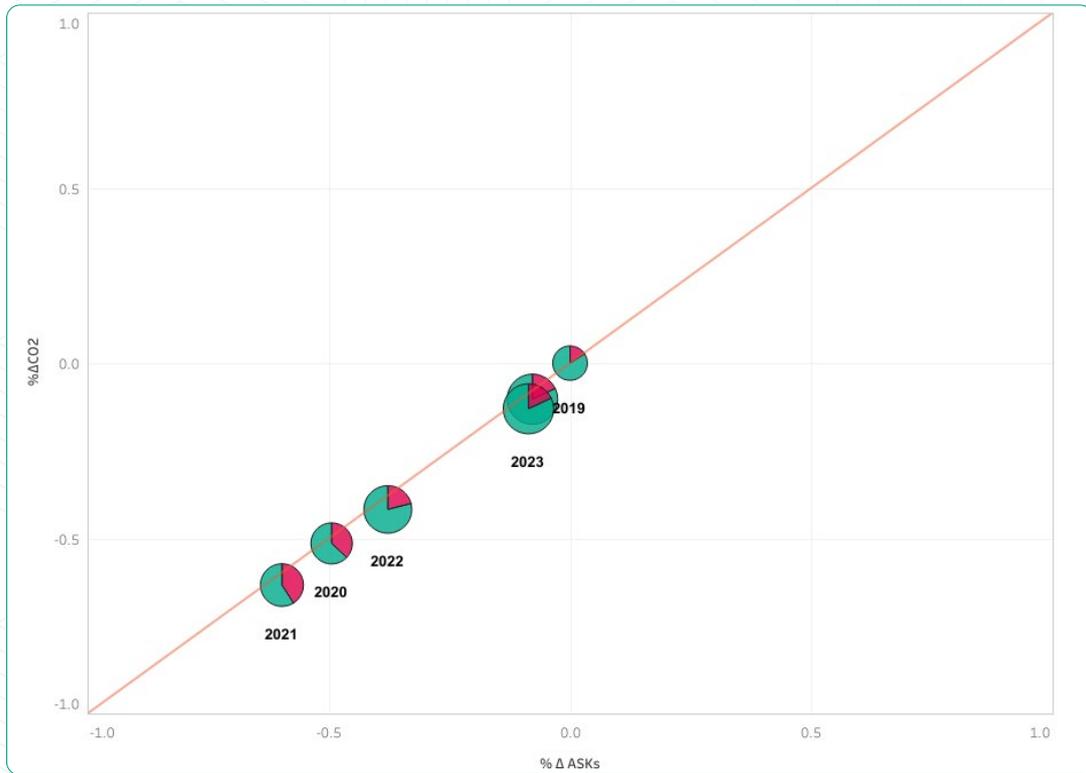
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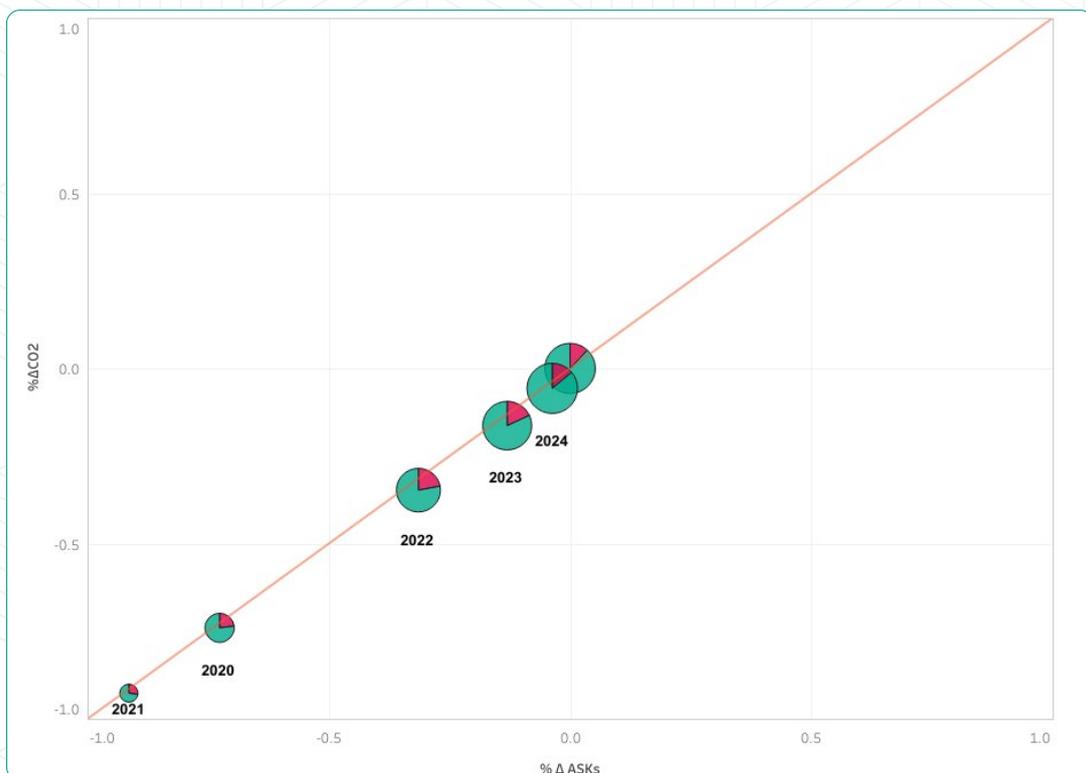
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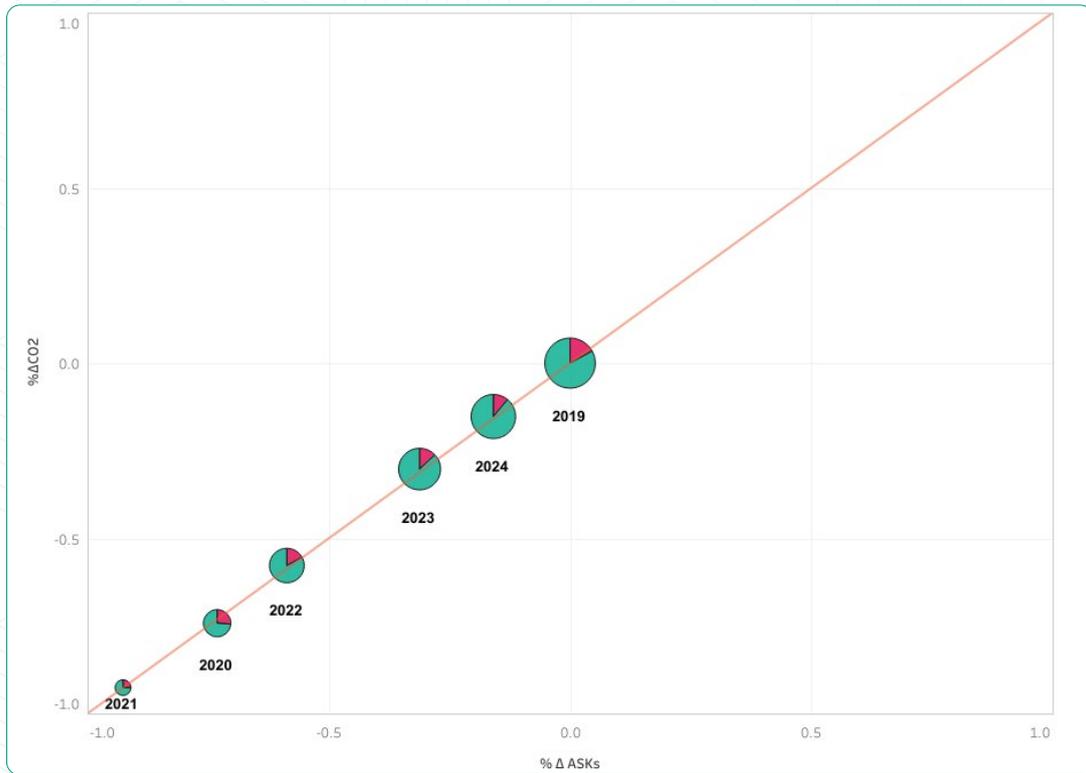
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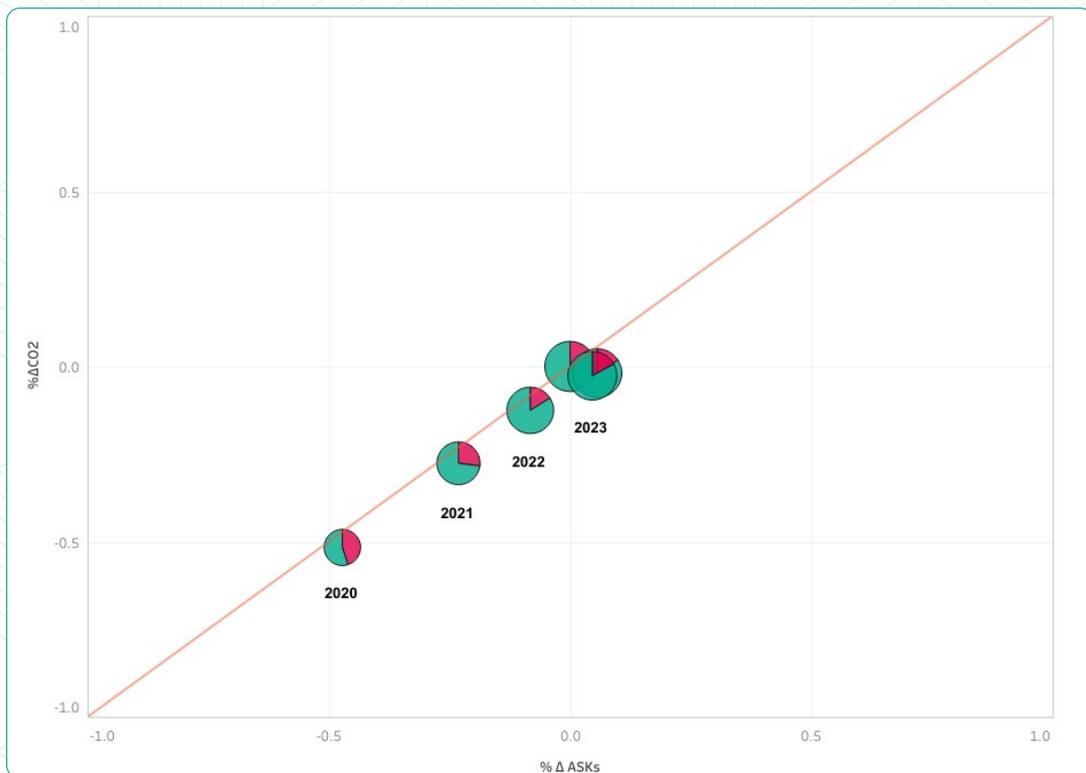
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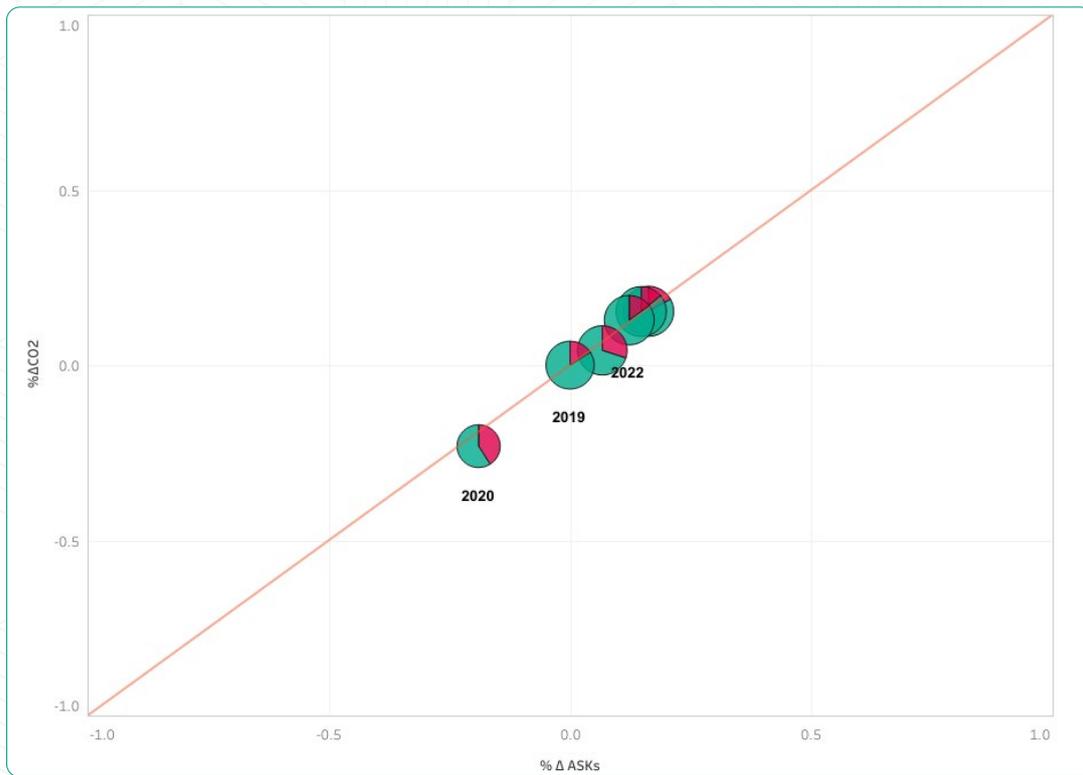
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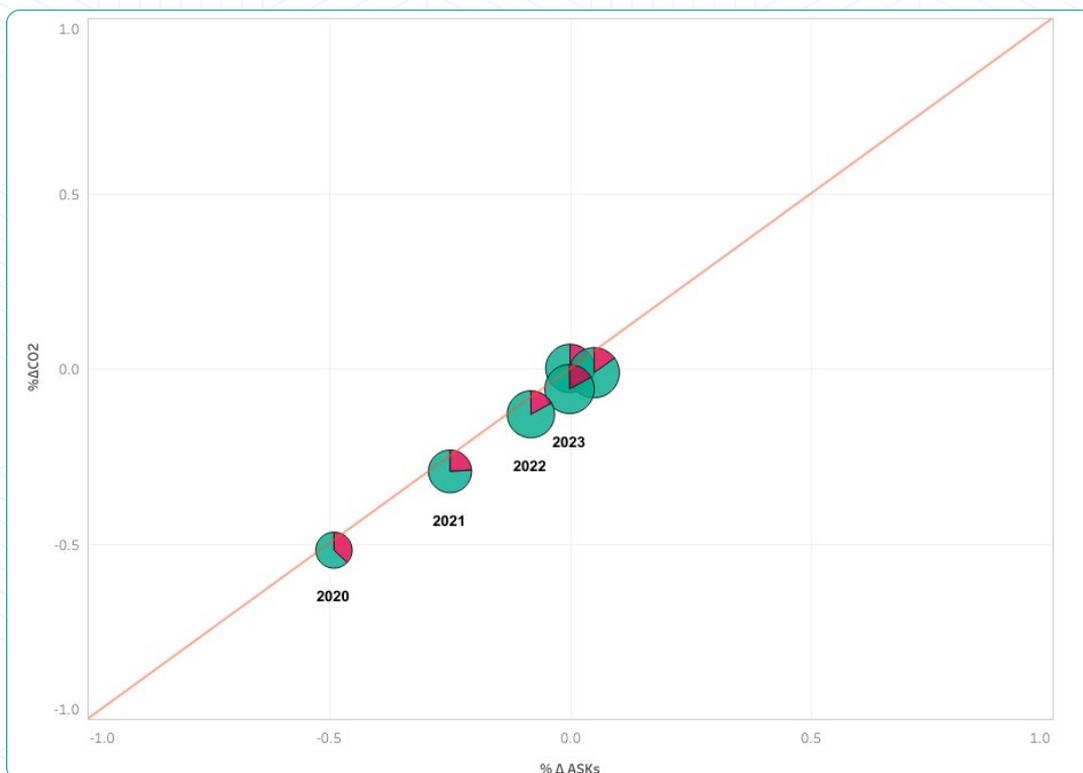
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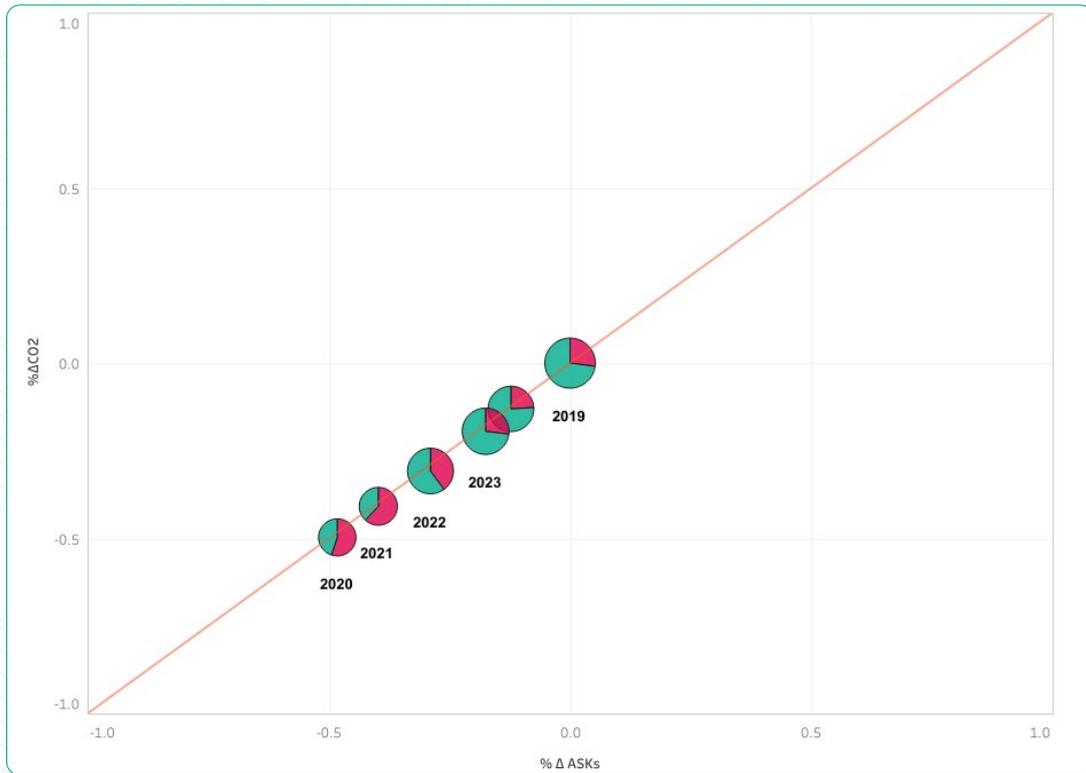
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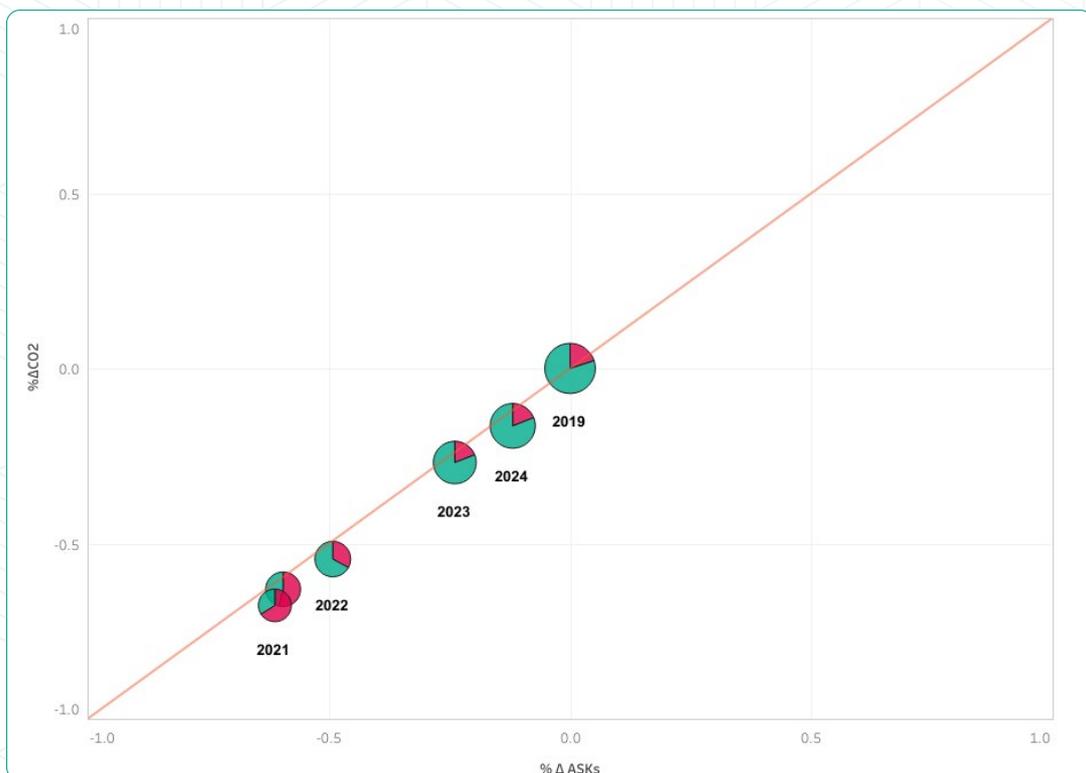
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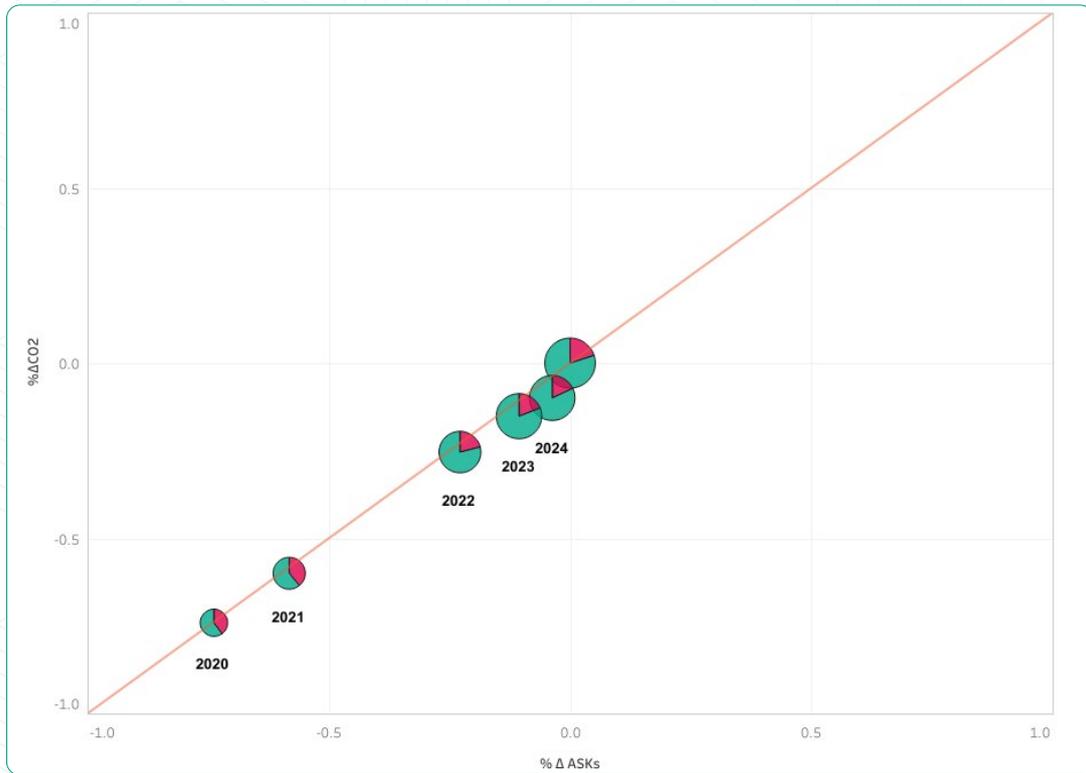
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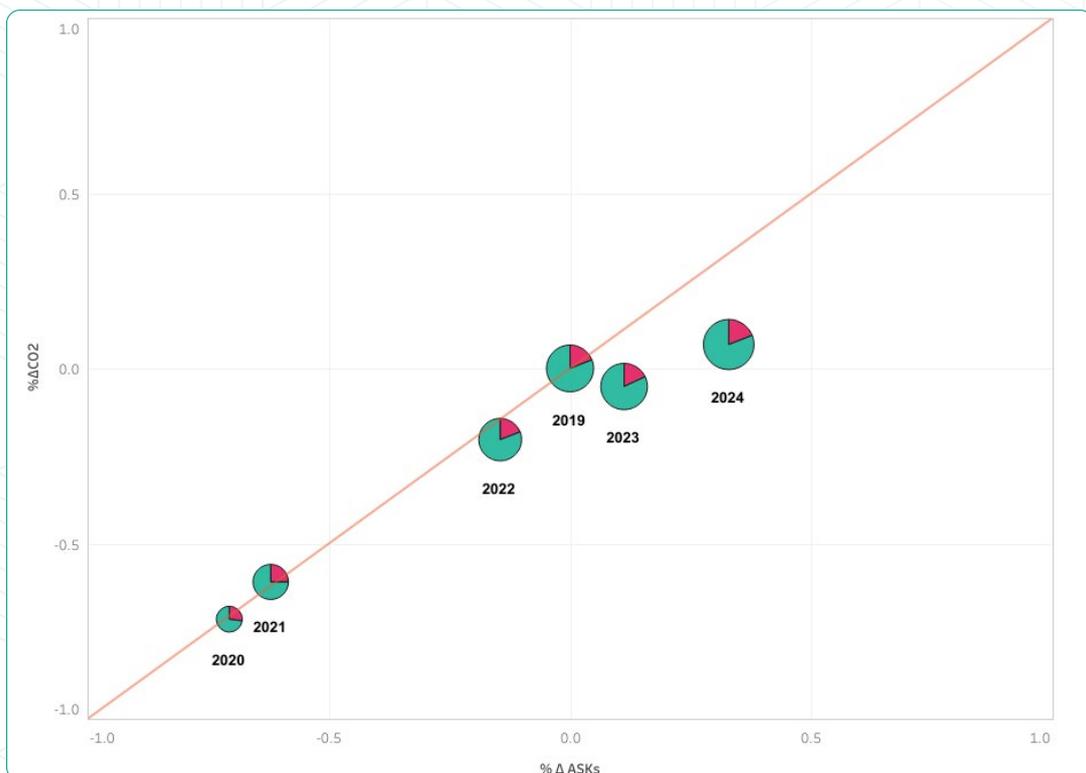
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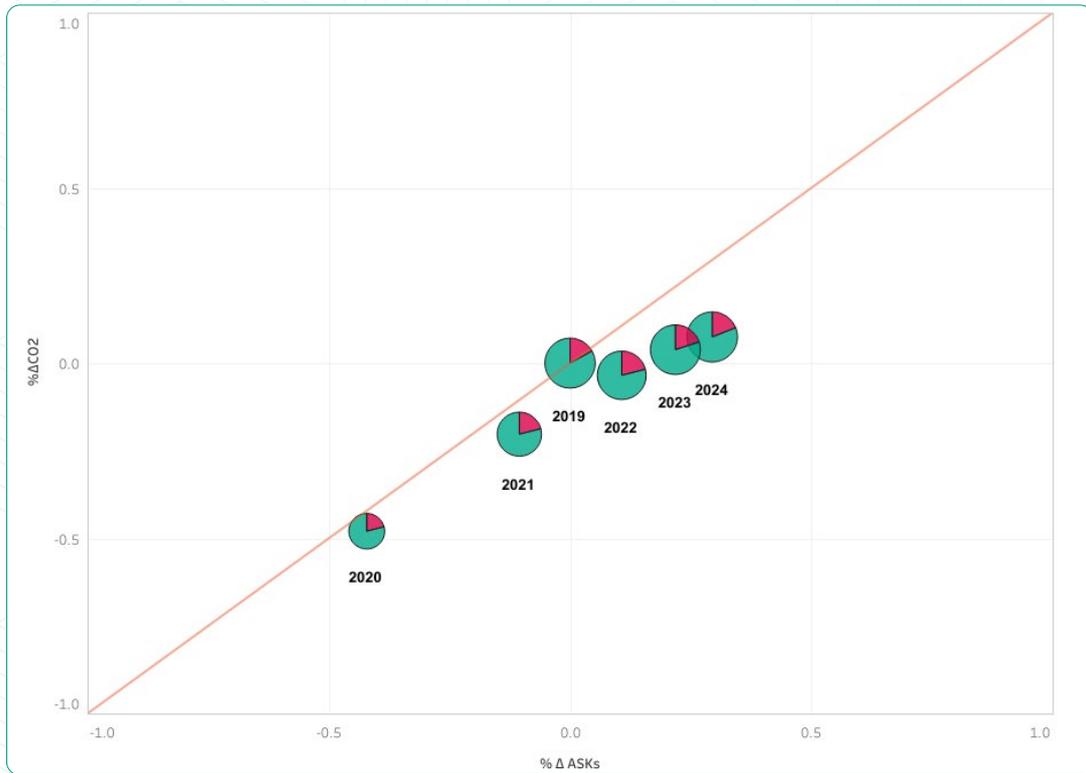
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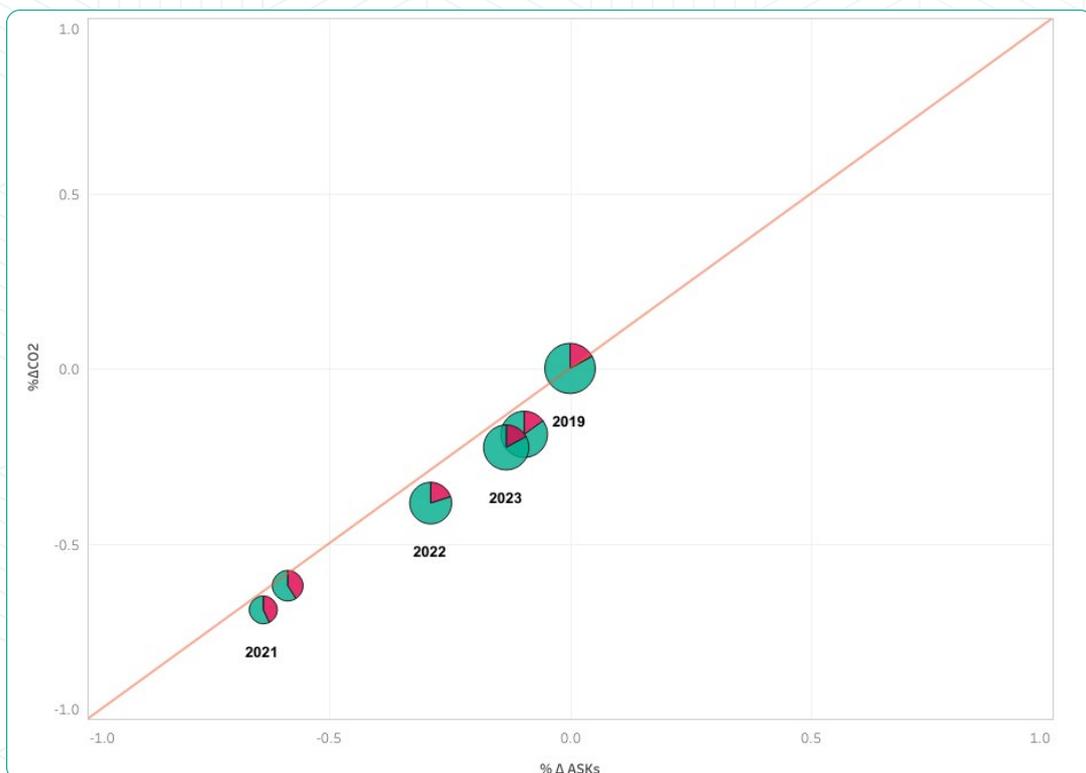
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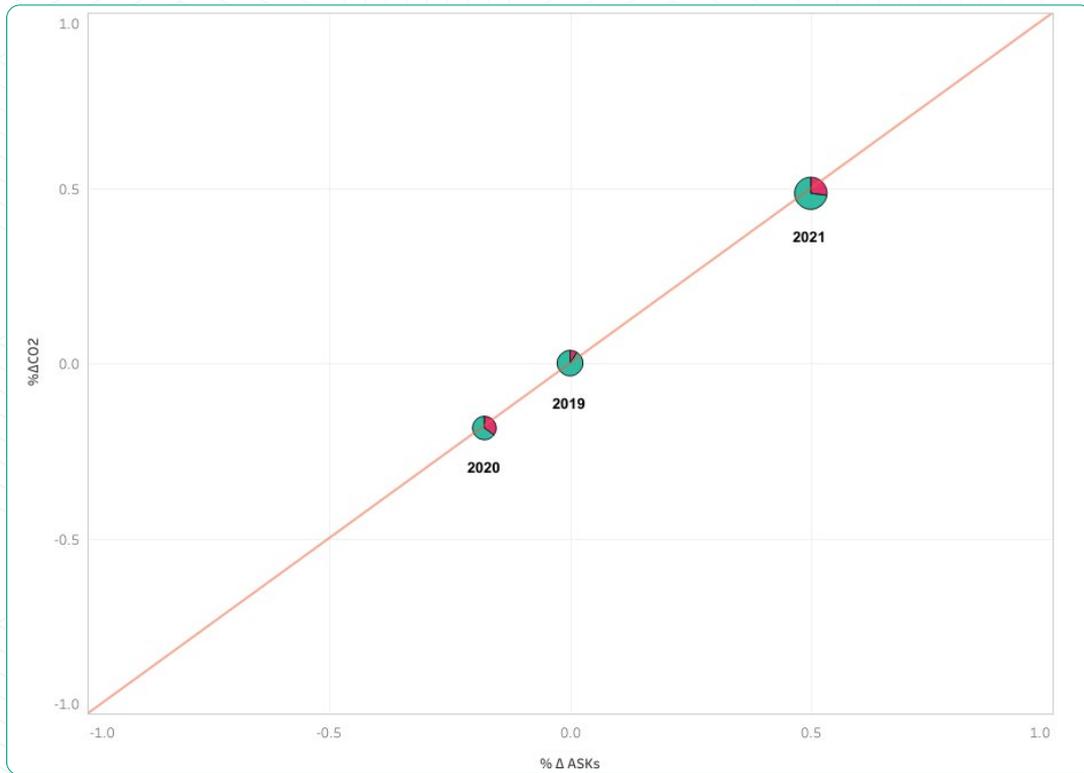
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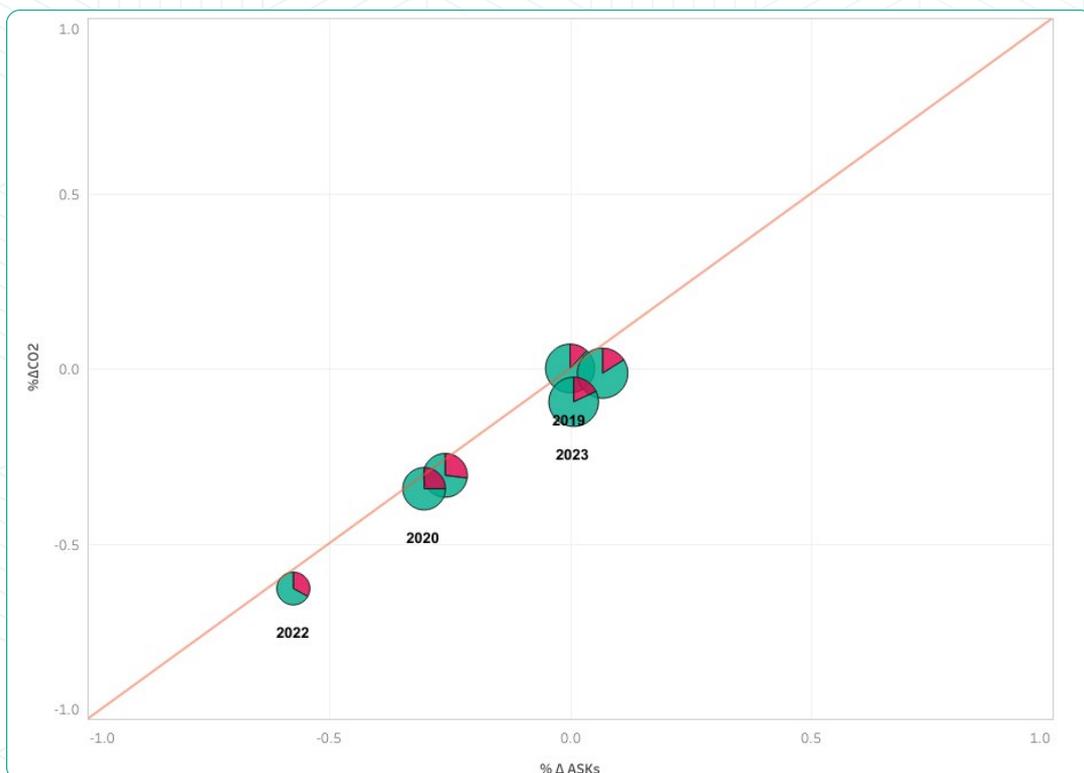


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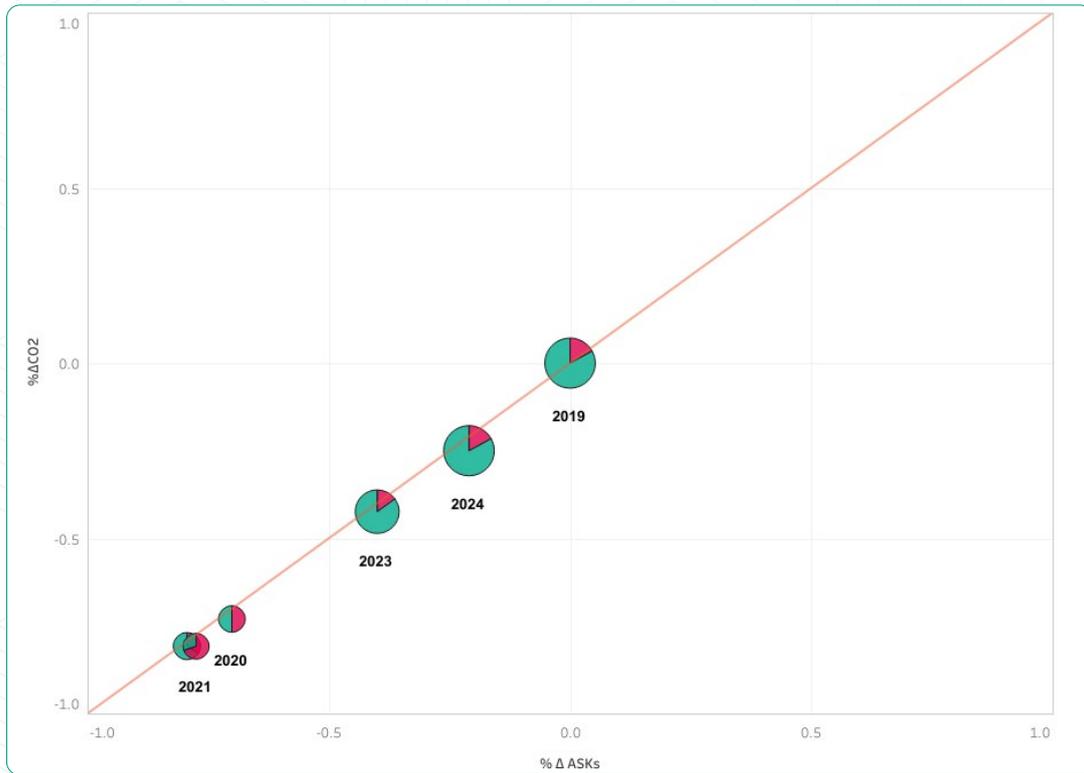


The bubbles do not appear for Buzz for 2022/23/24 as they did not meet the scale parameters.

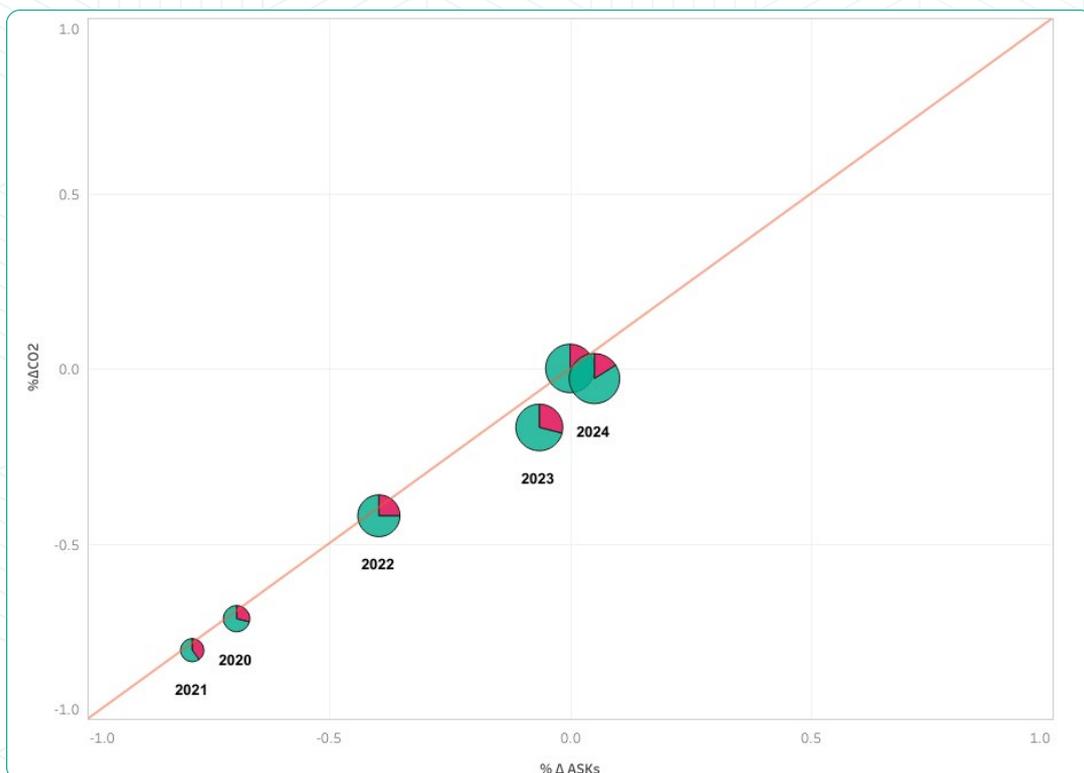
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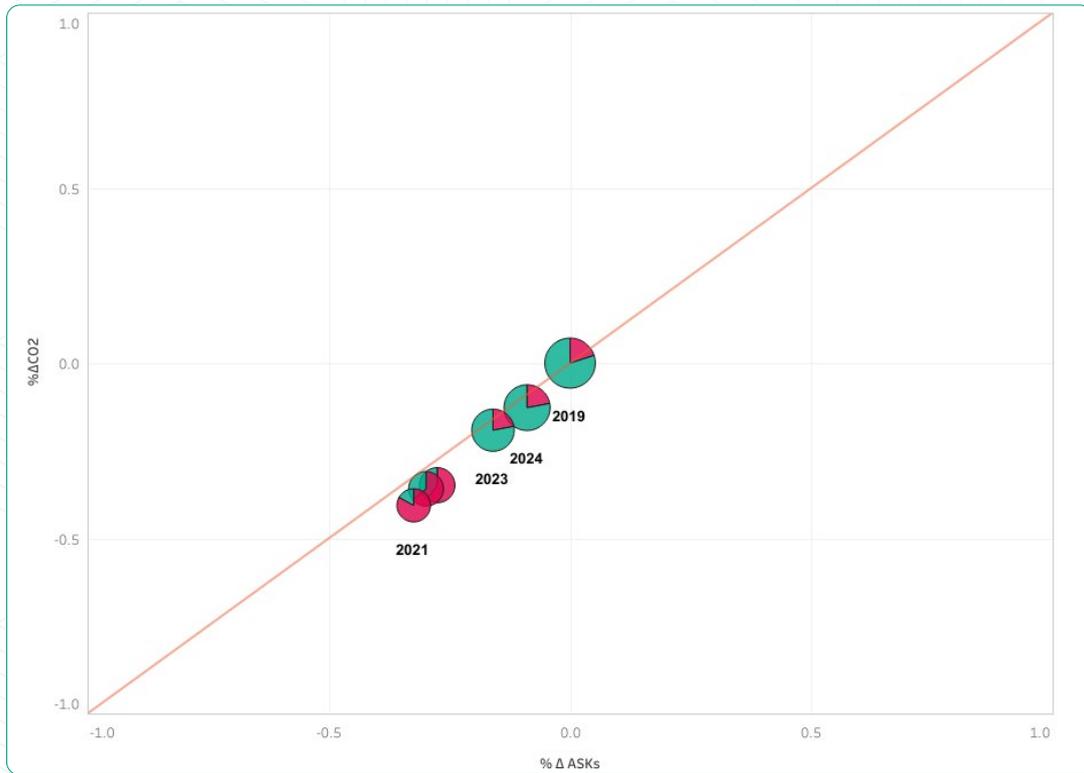
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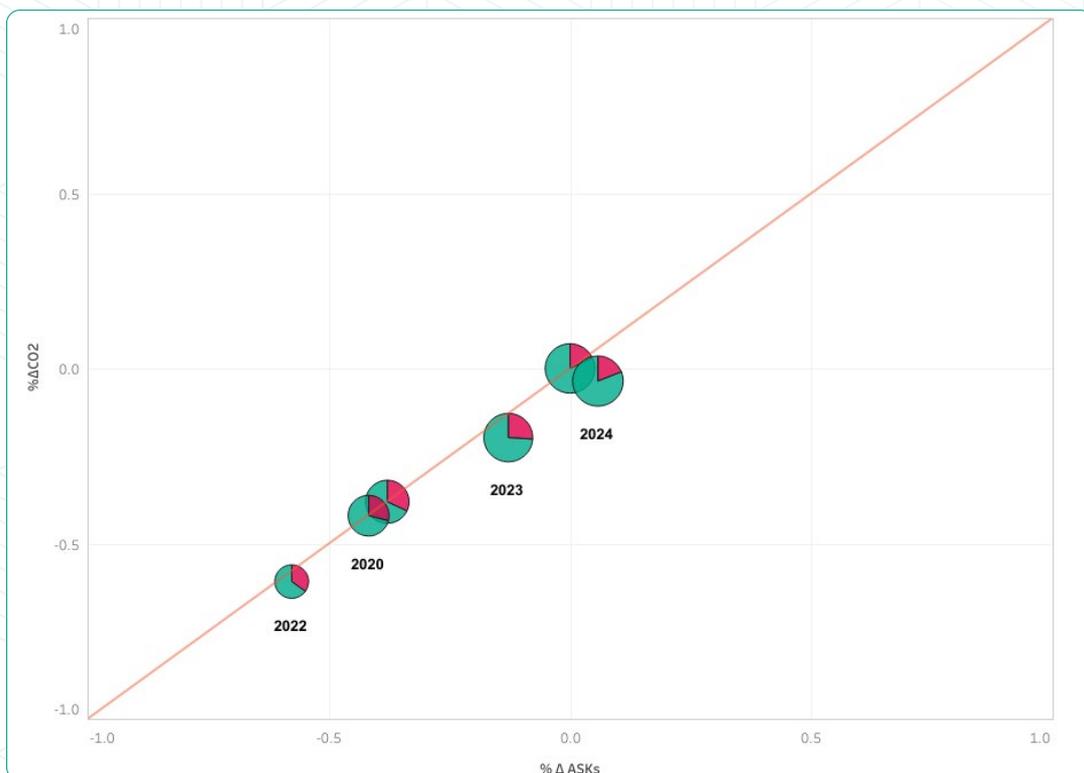
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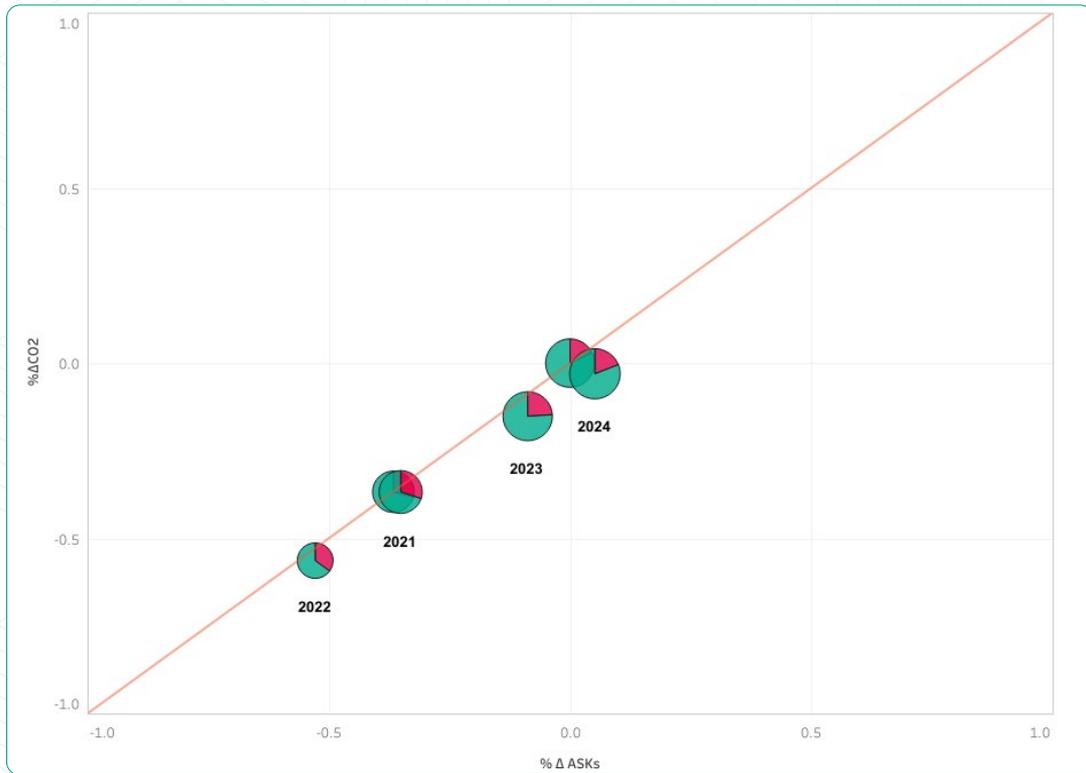
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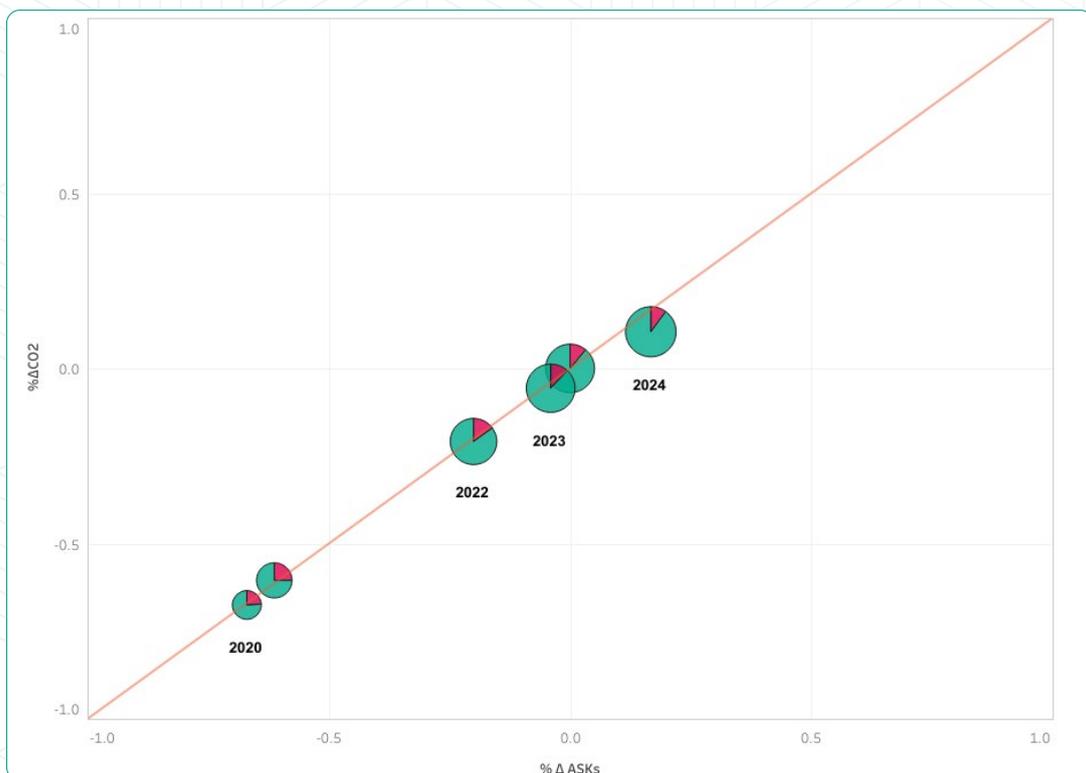
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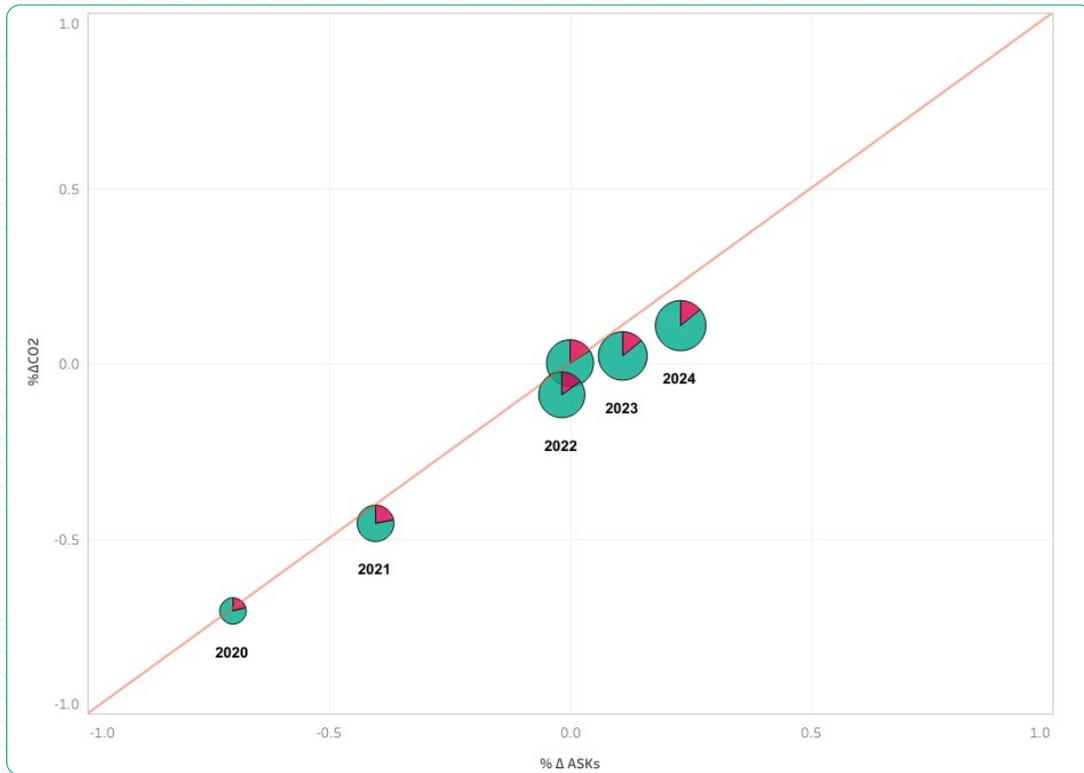
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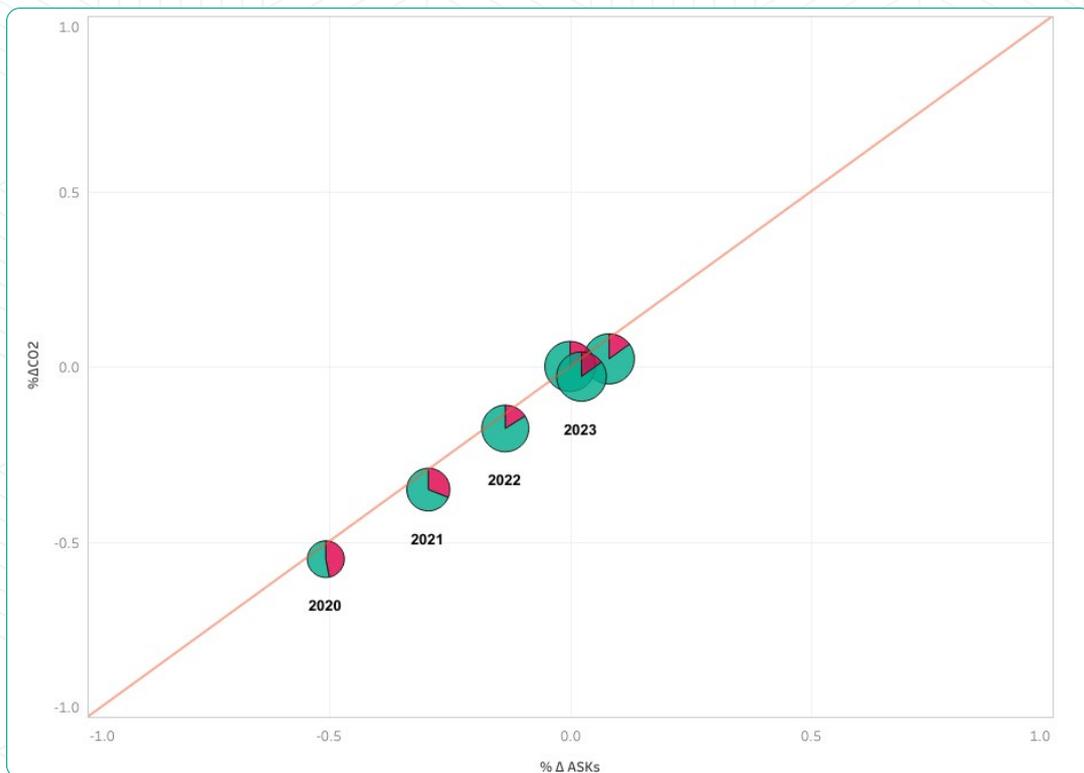
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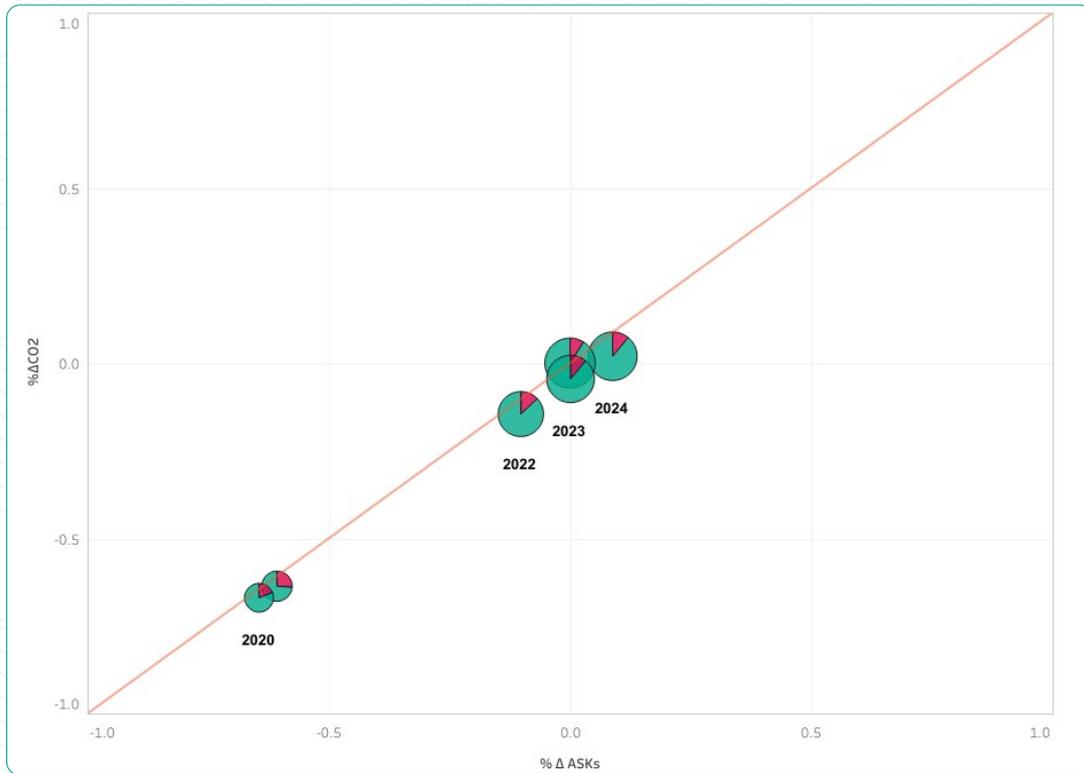
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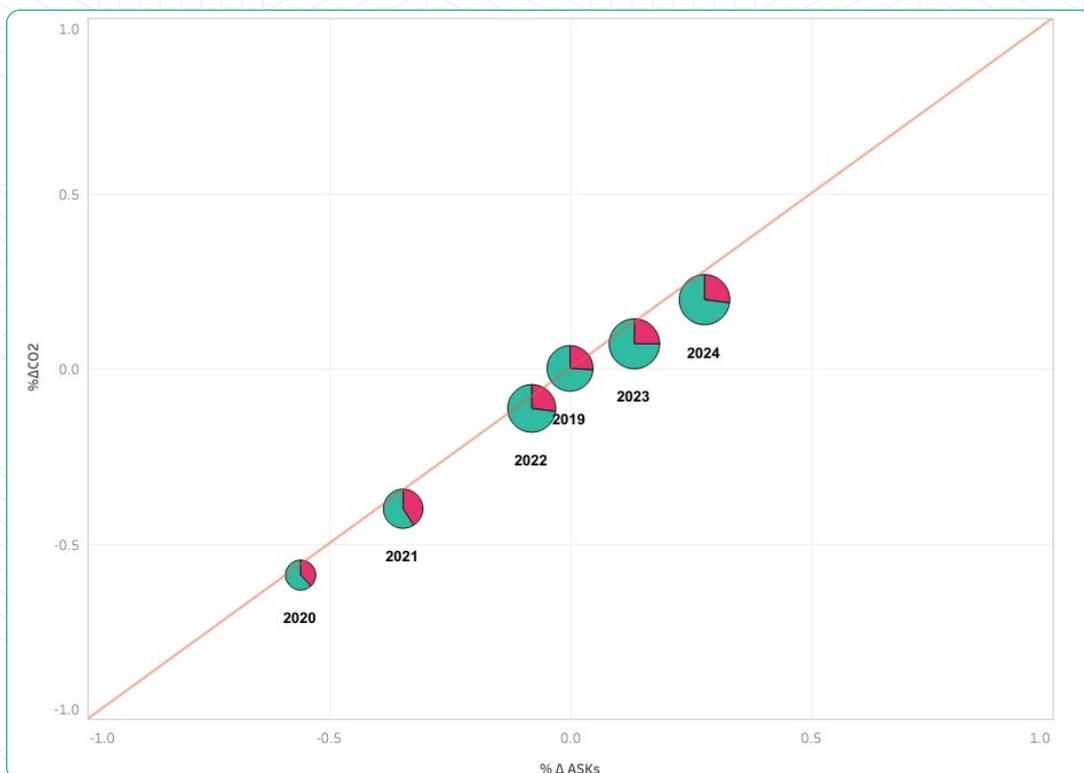
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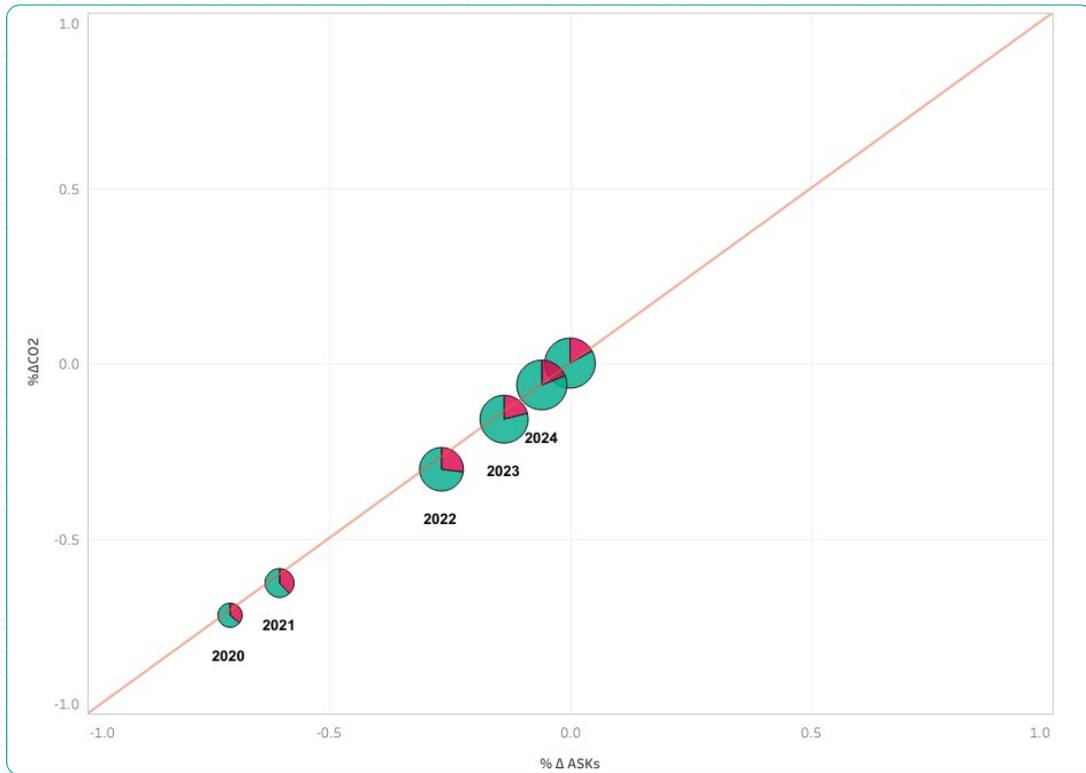
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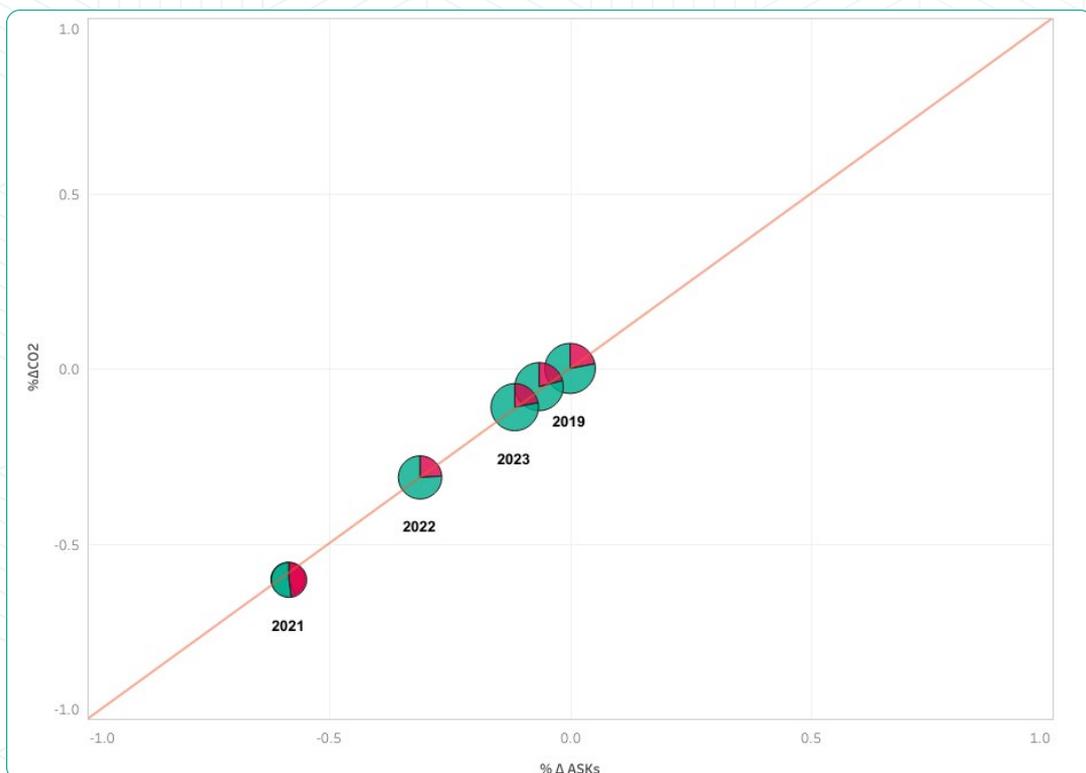
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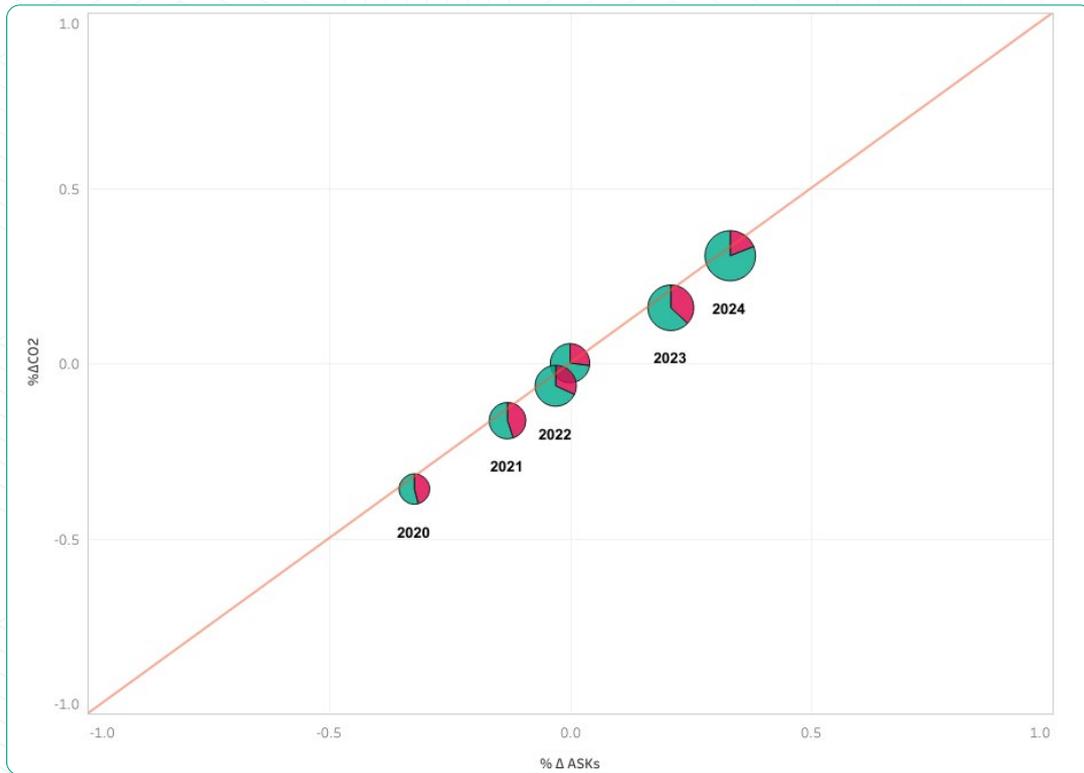
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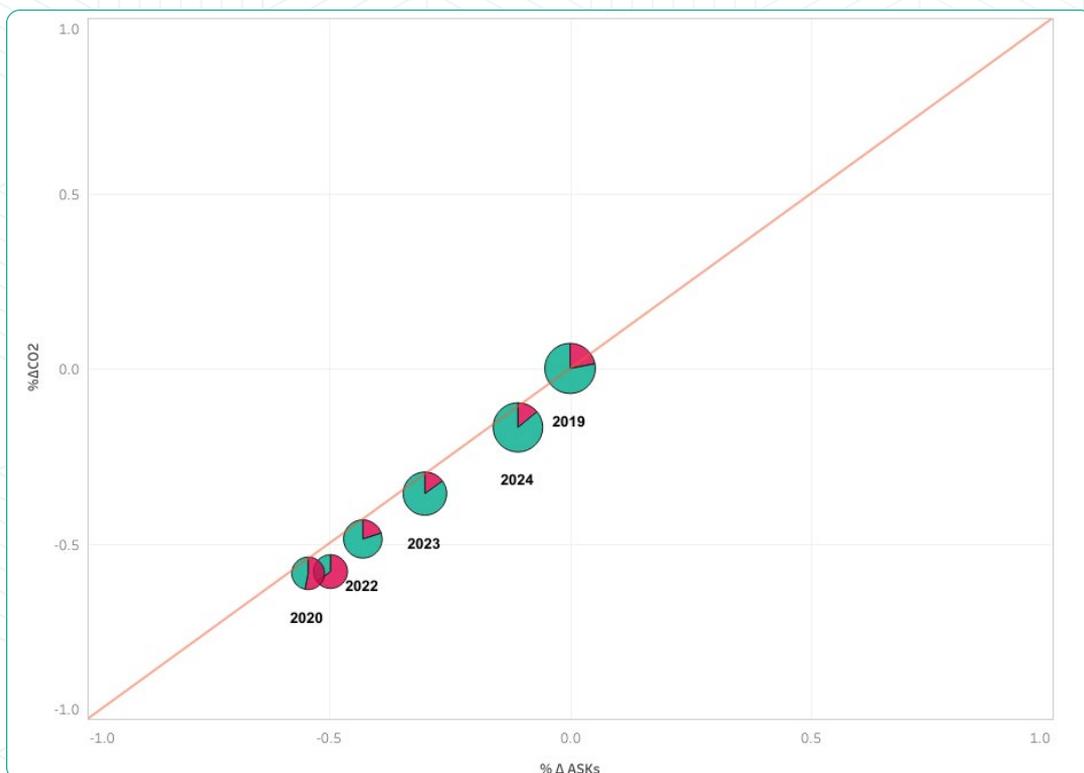
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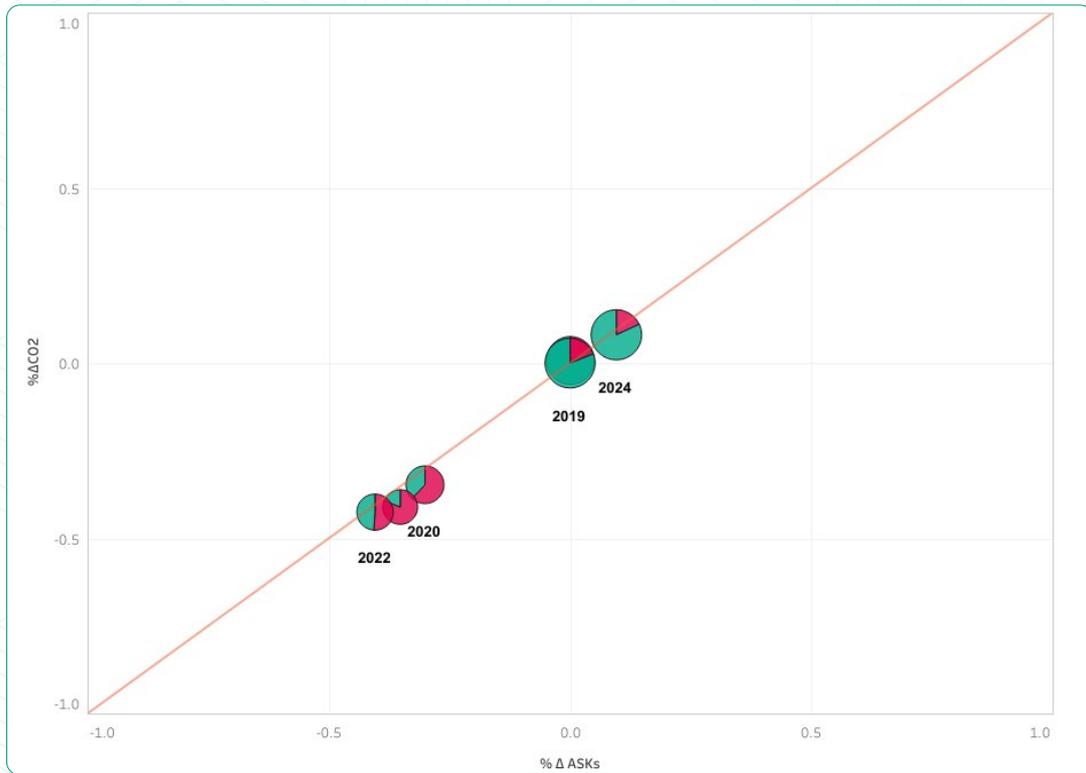
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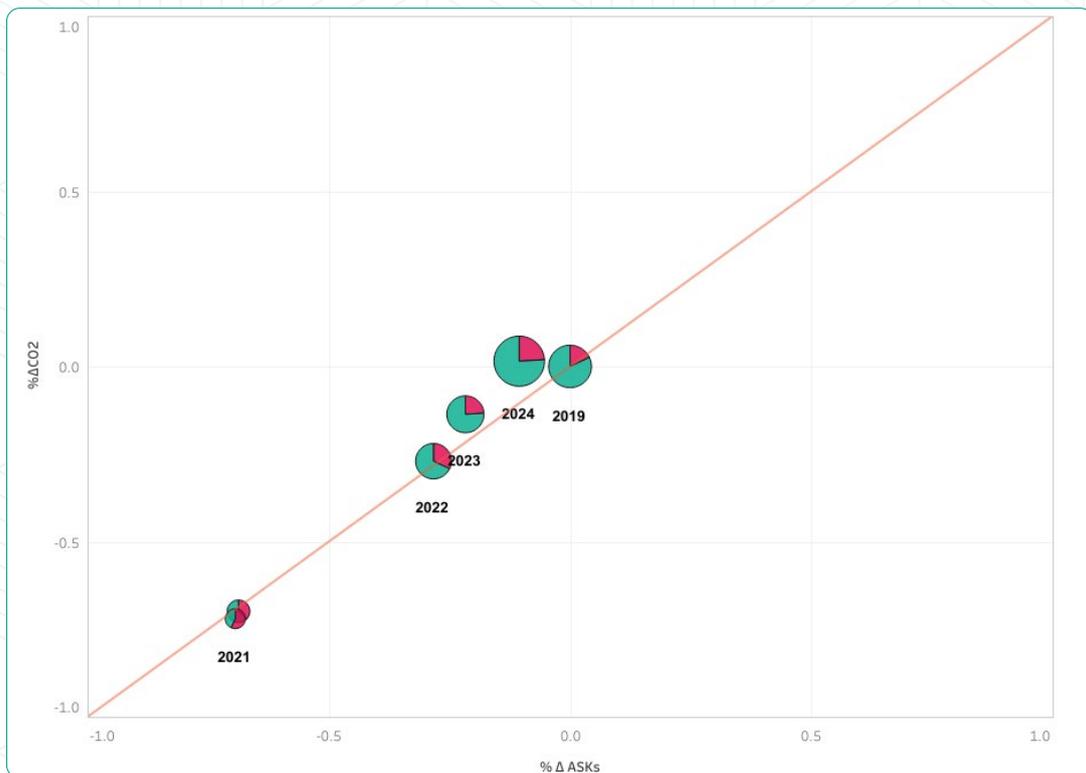
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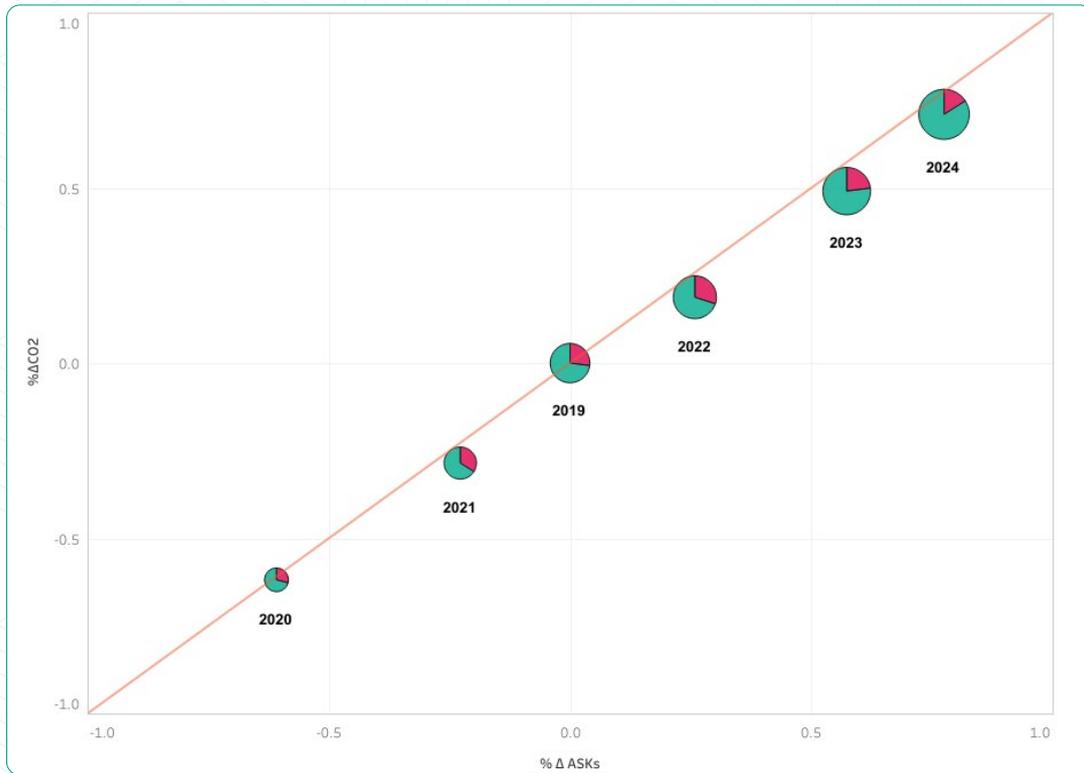
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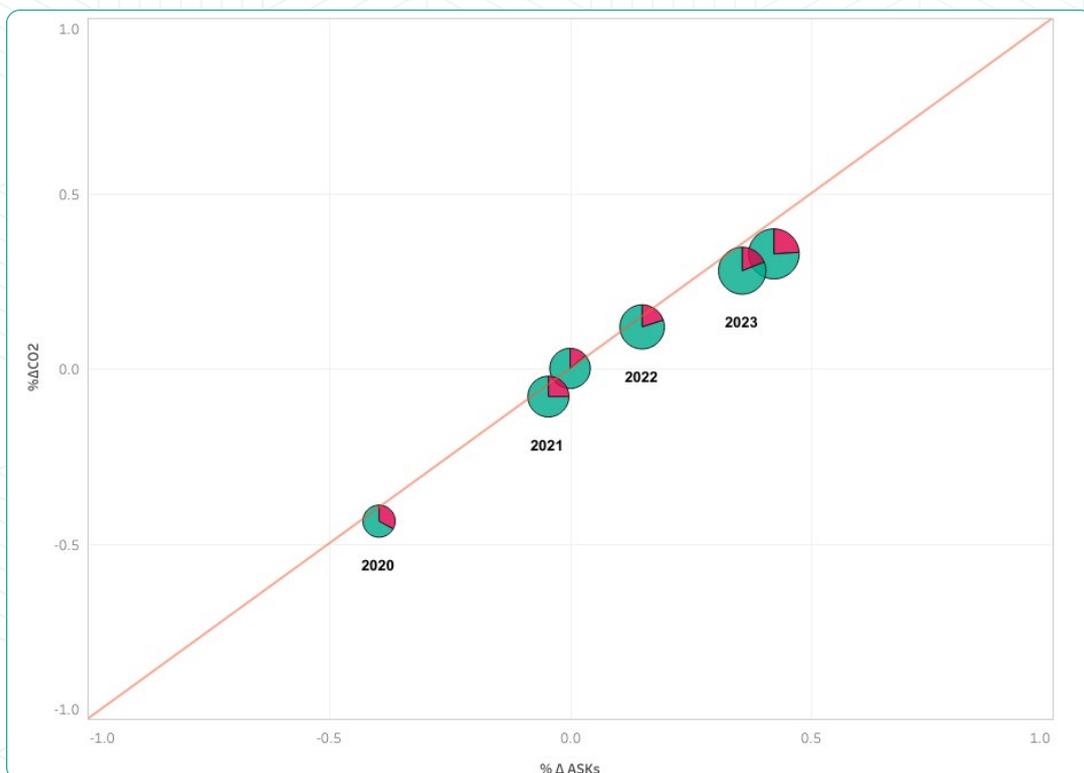
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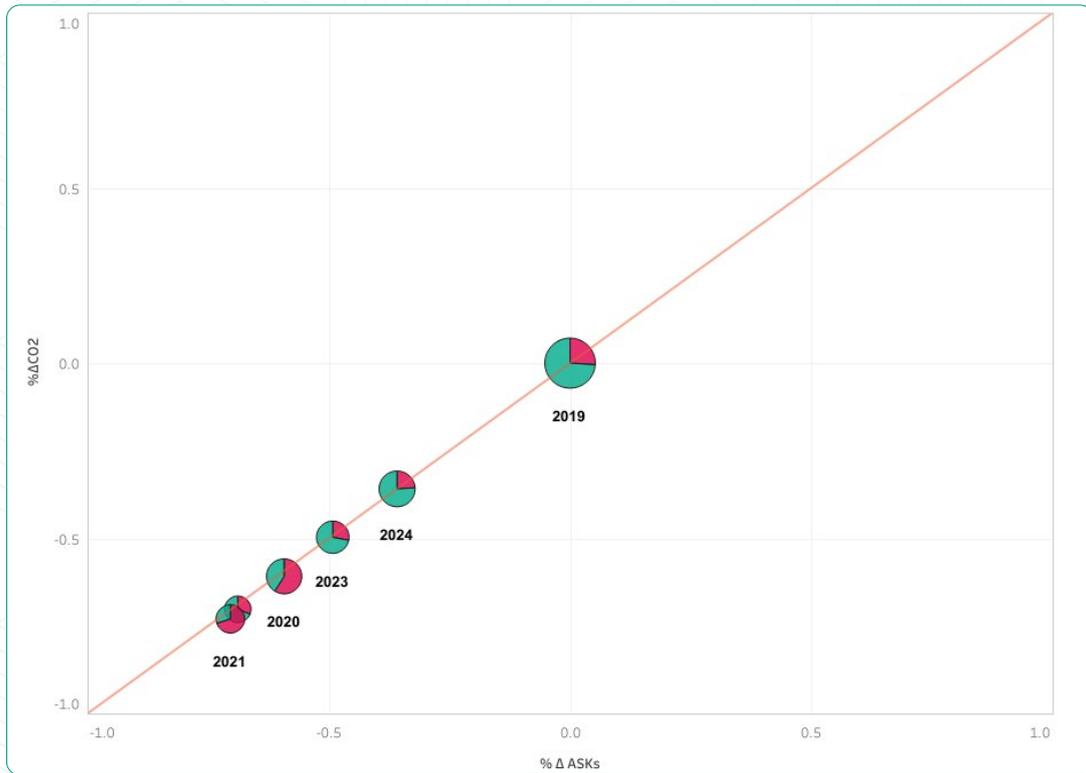
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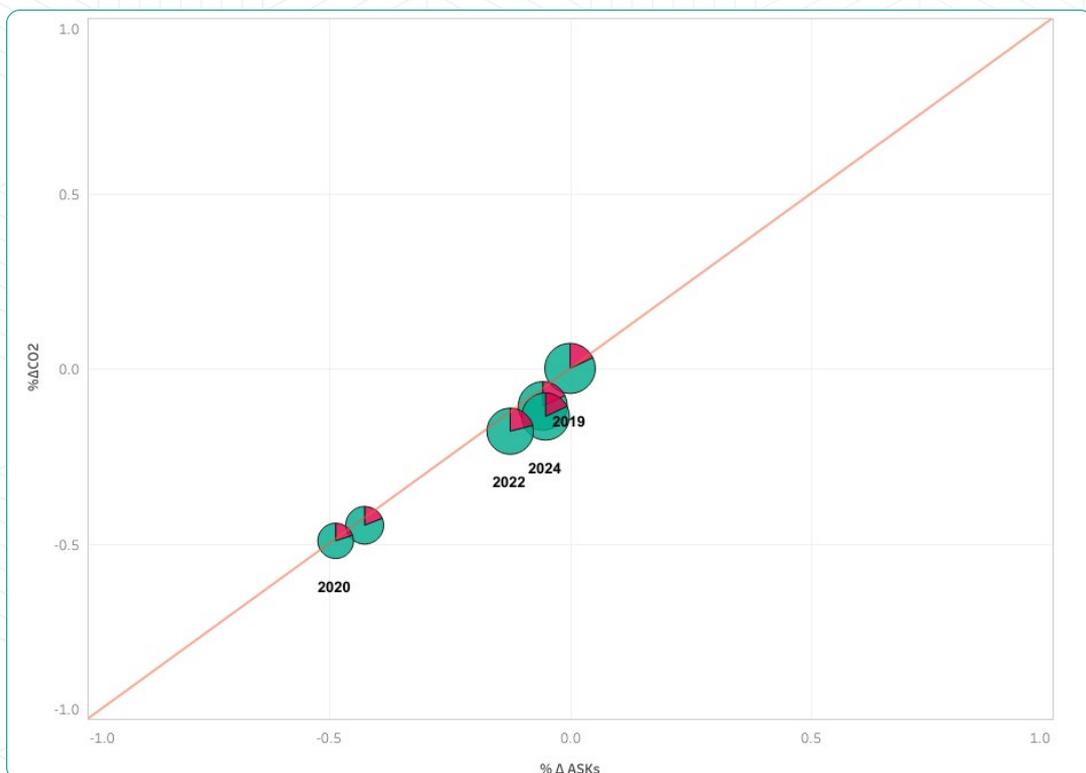
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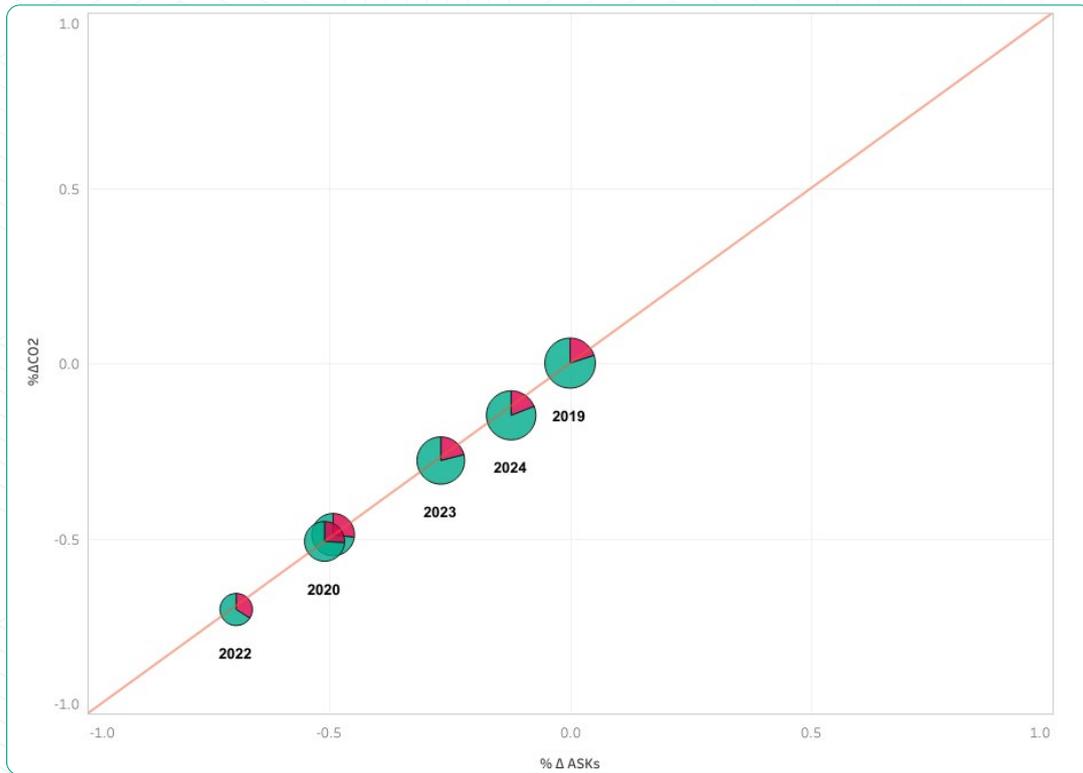
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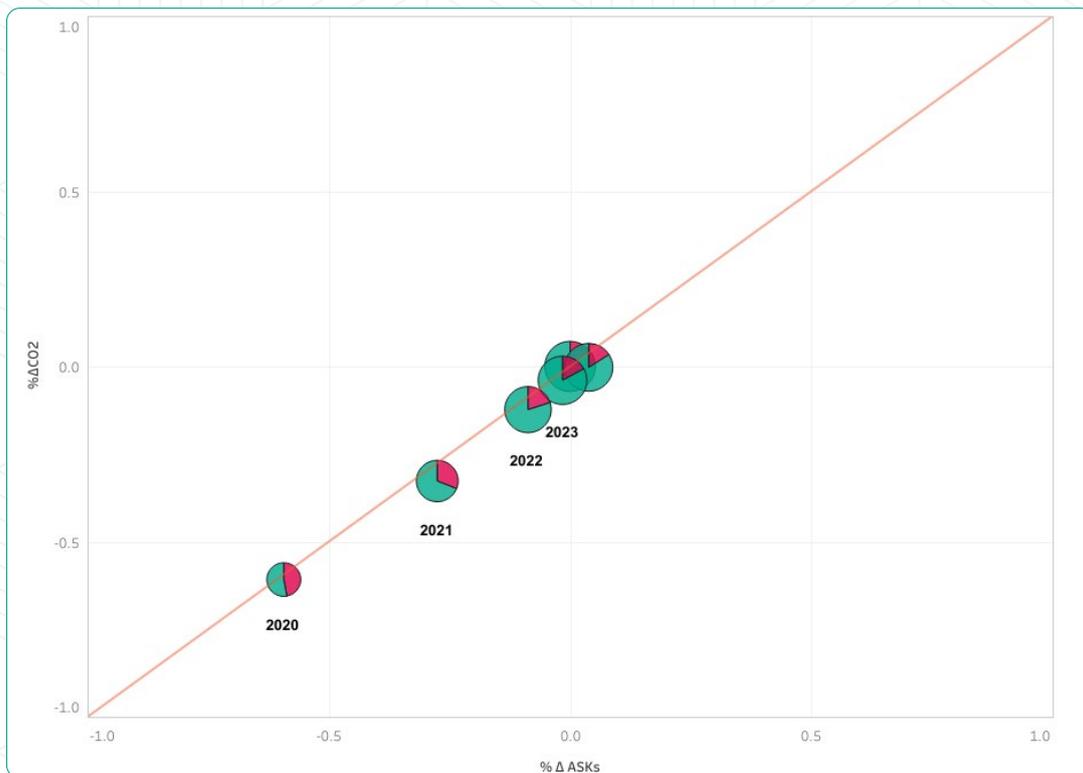
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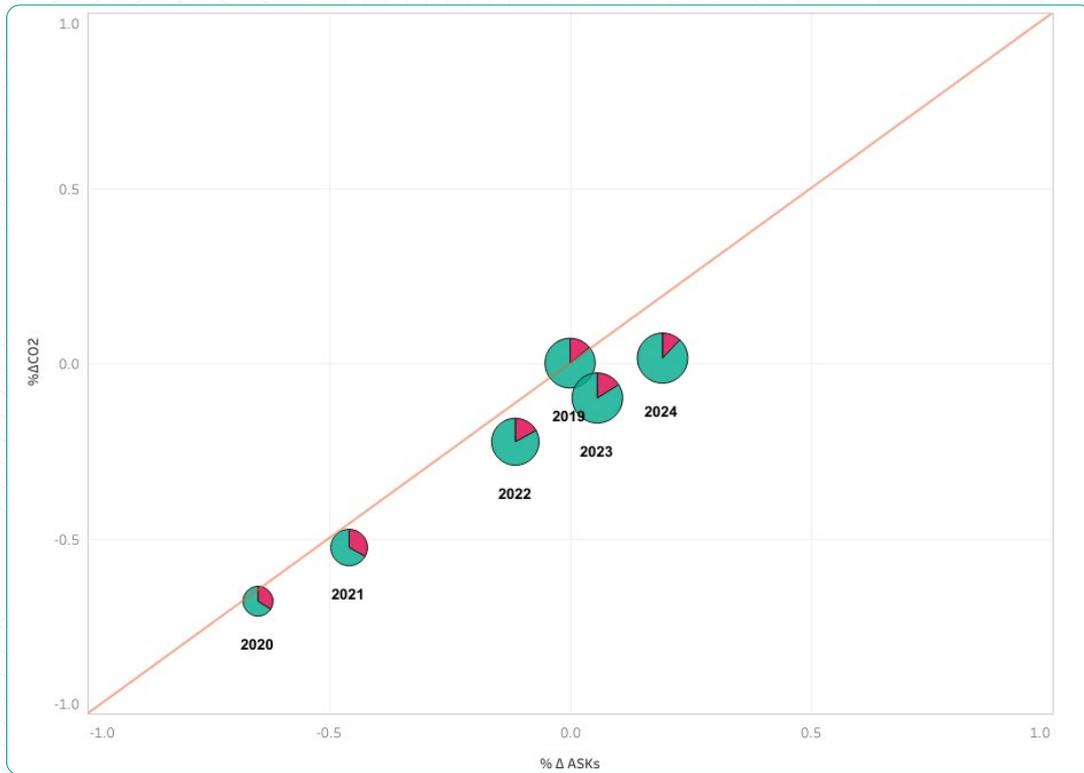
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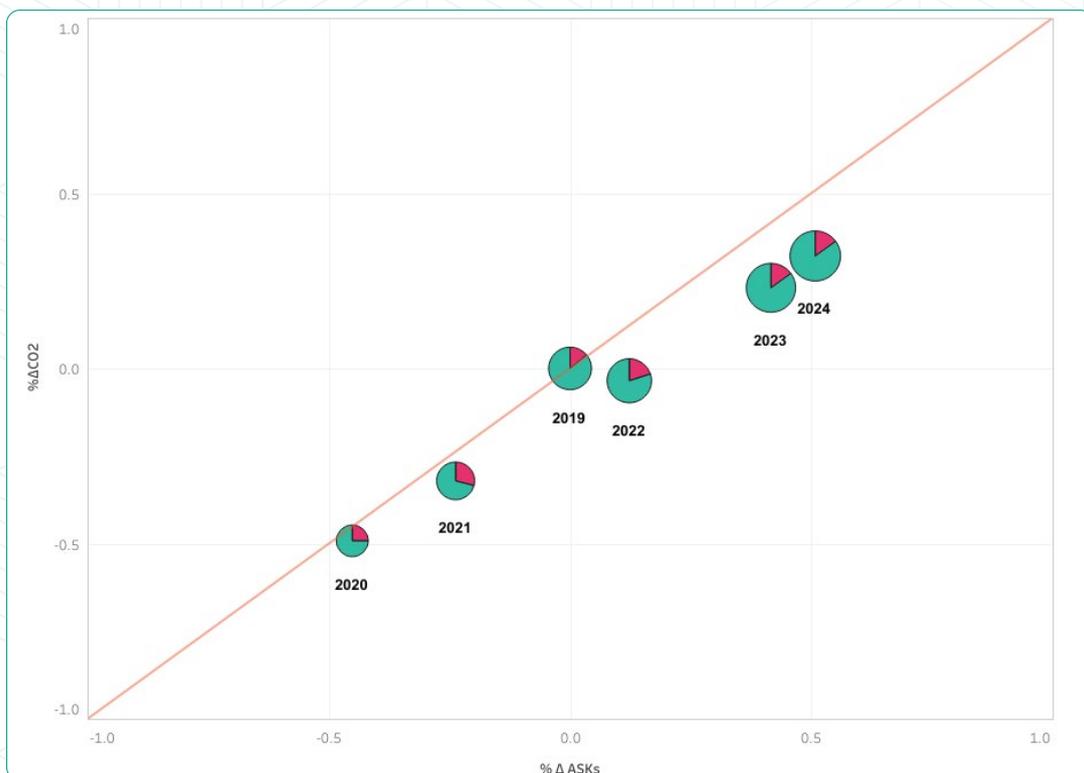
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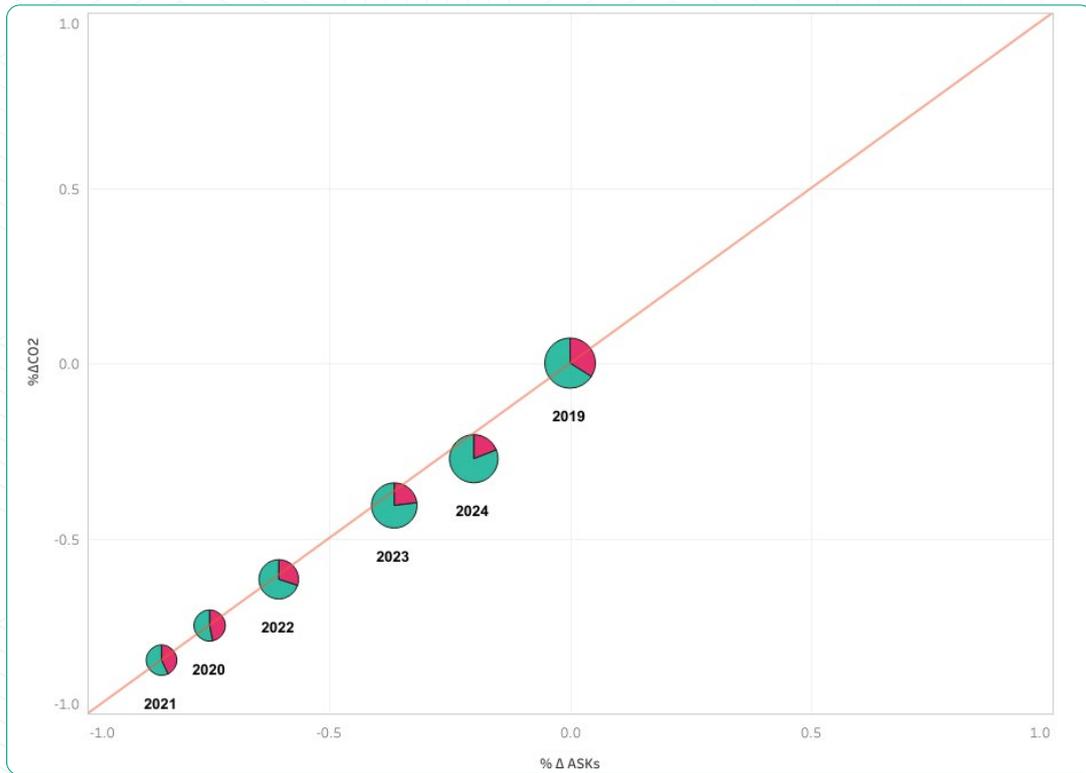
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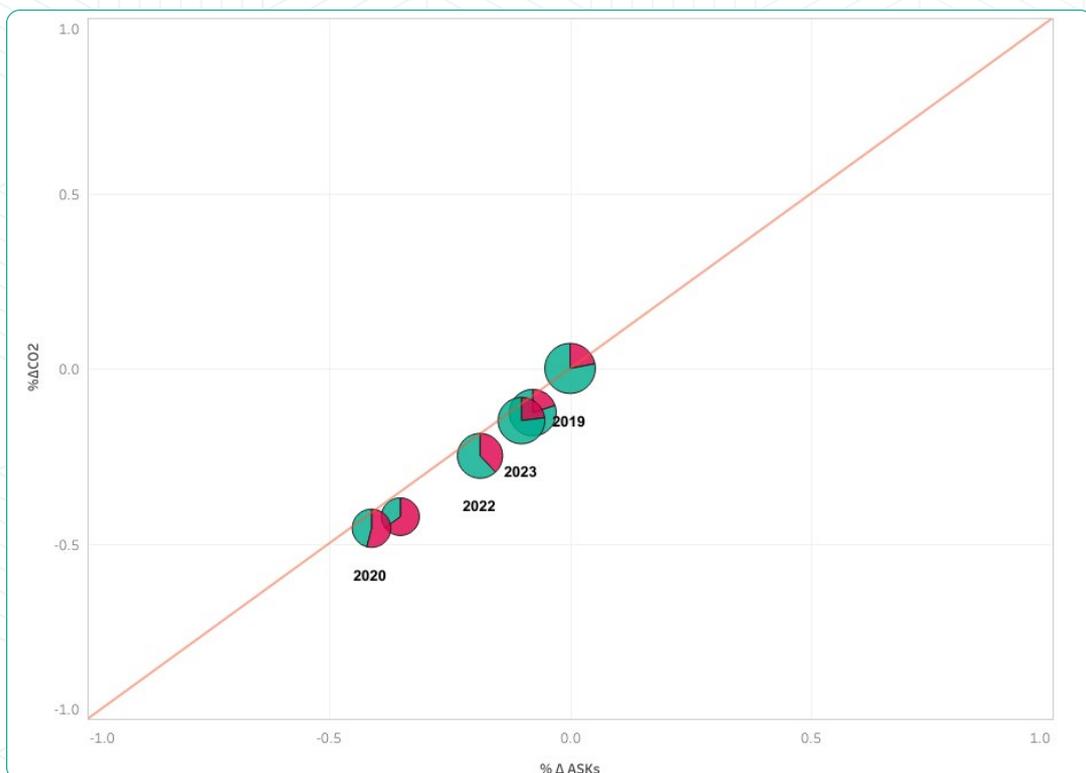
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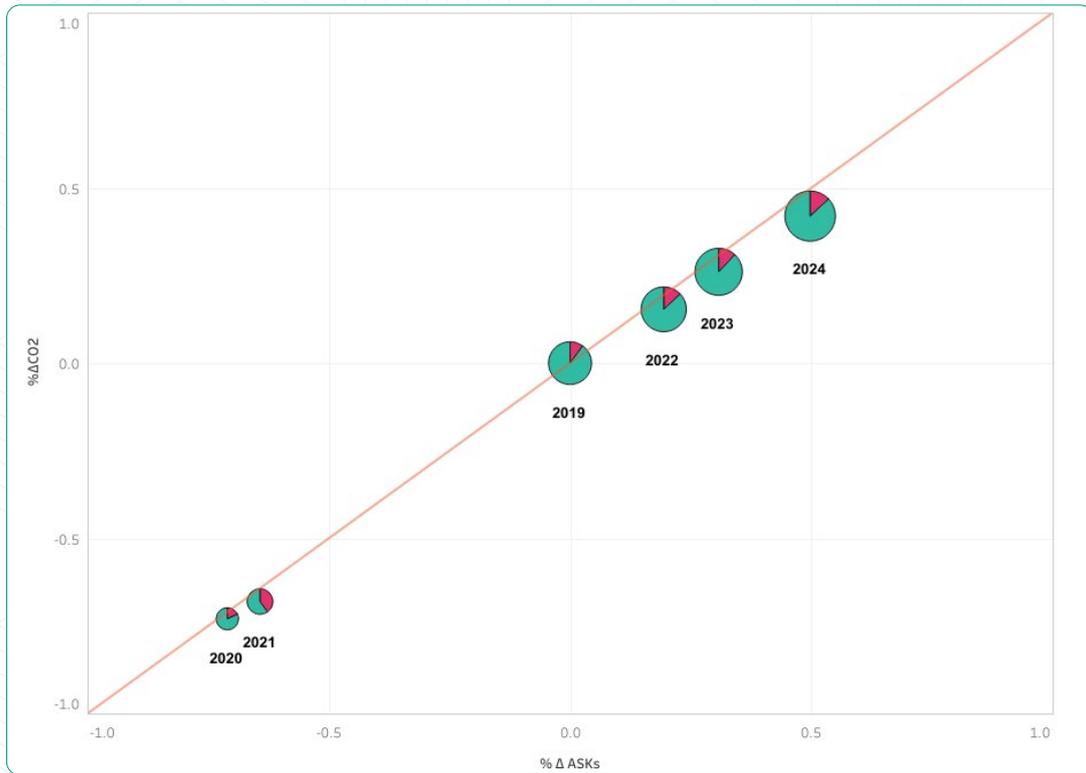
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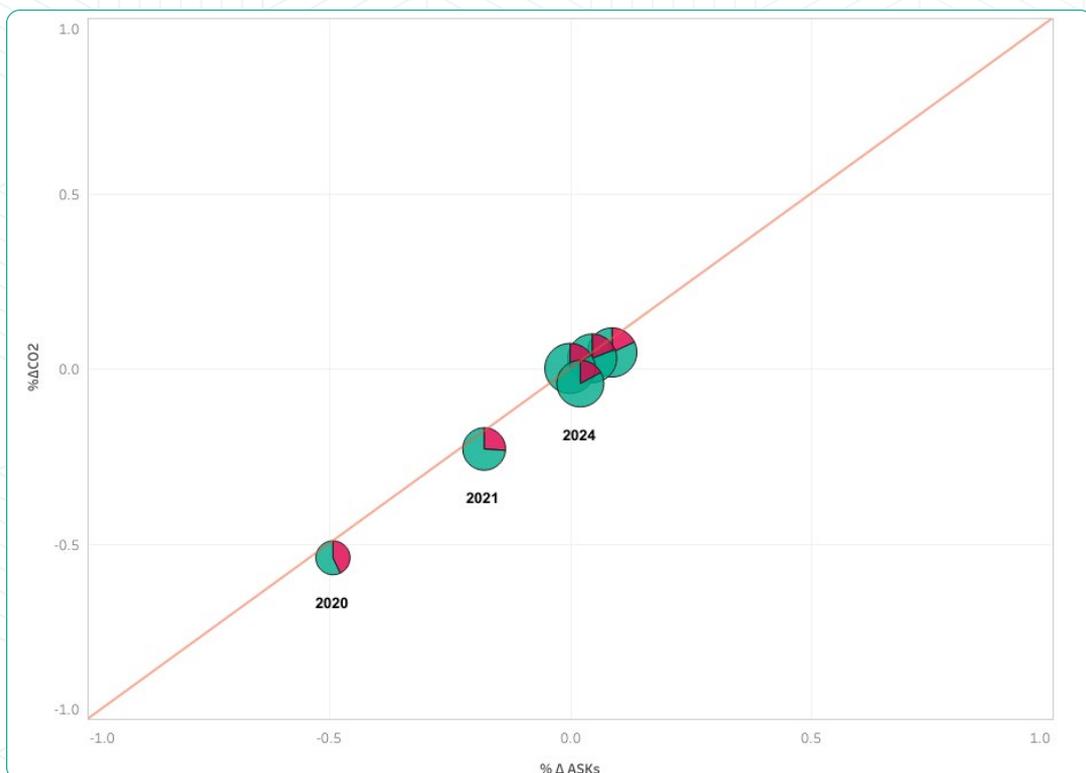
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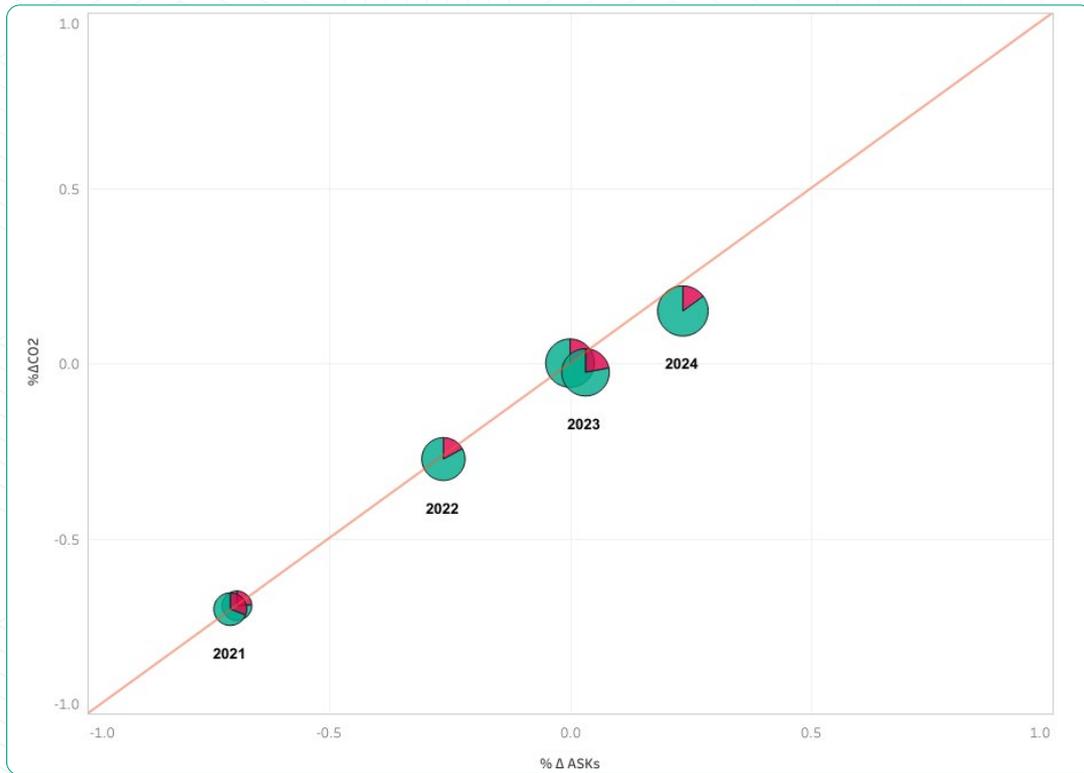
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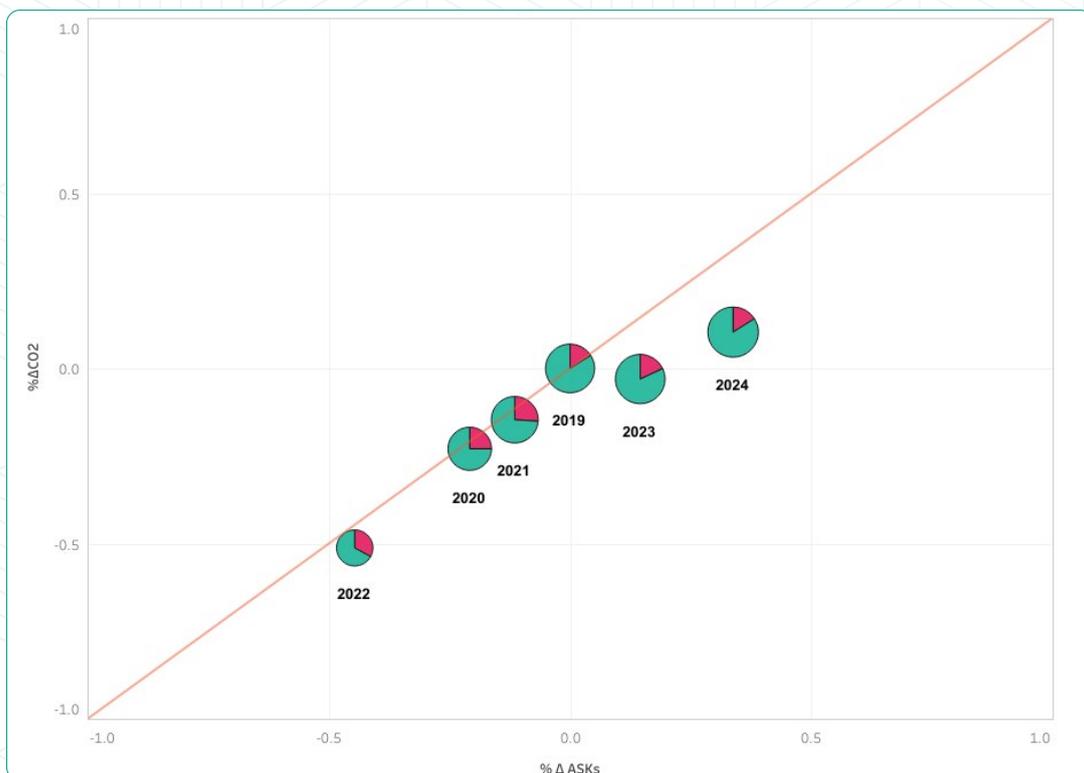
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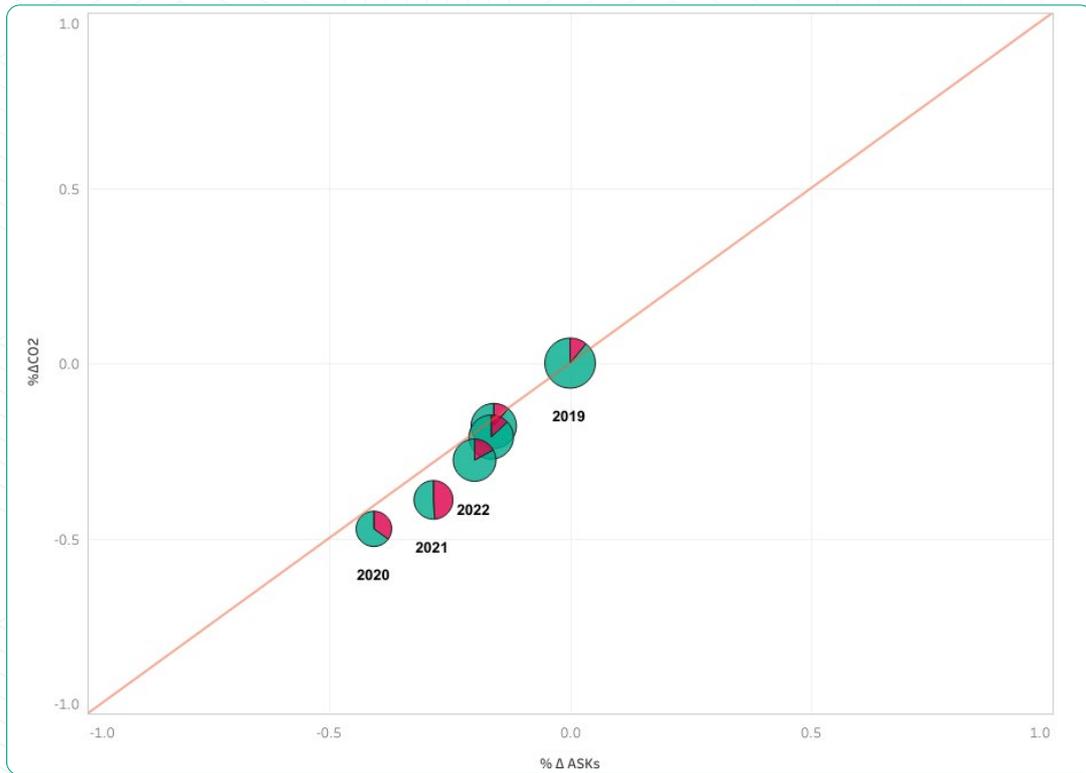
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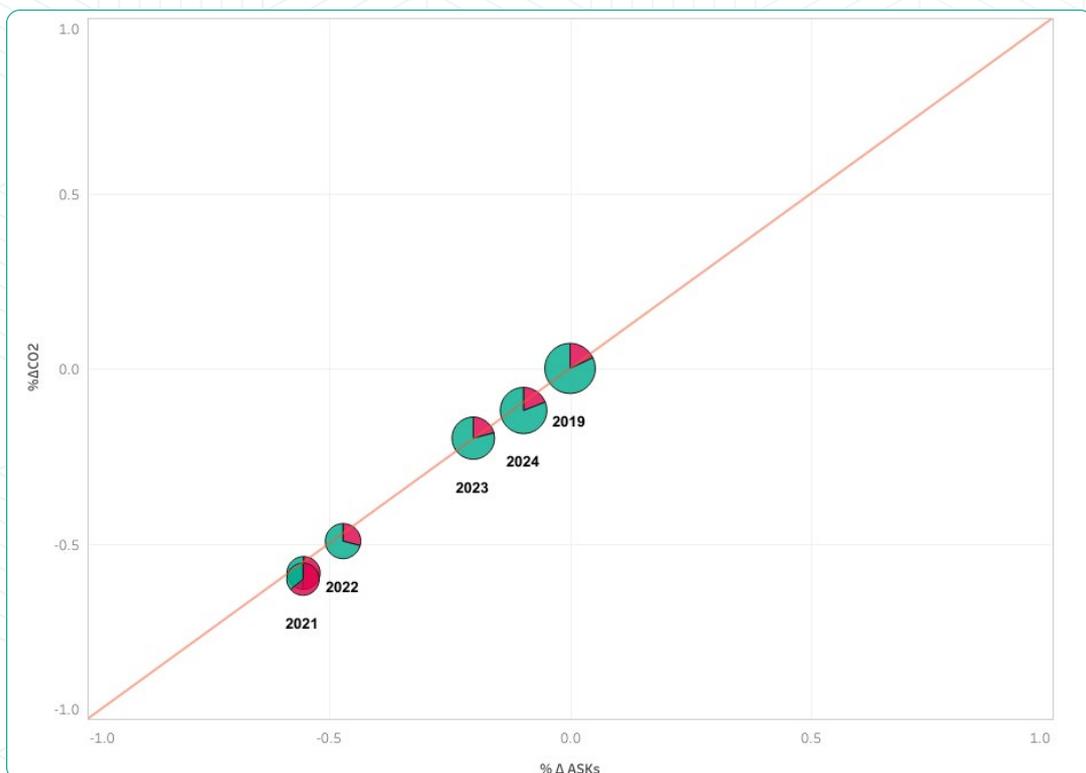
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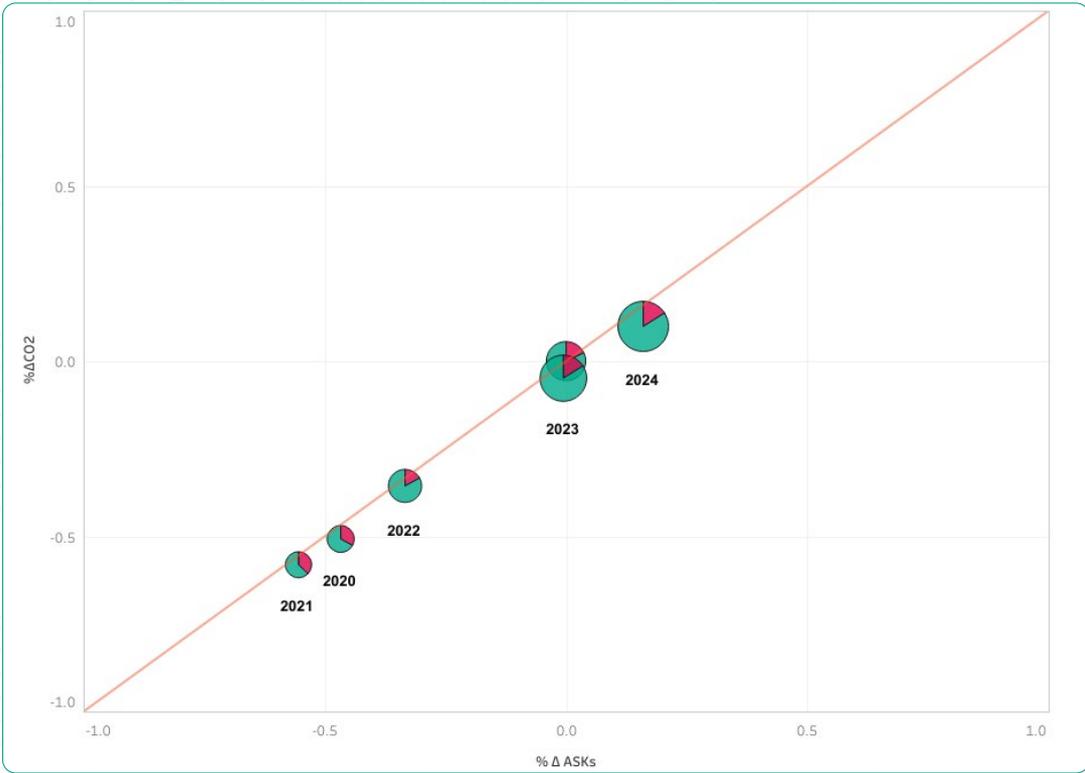
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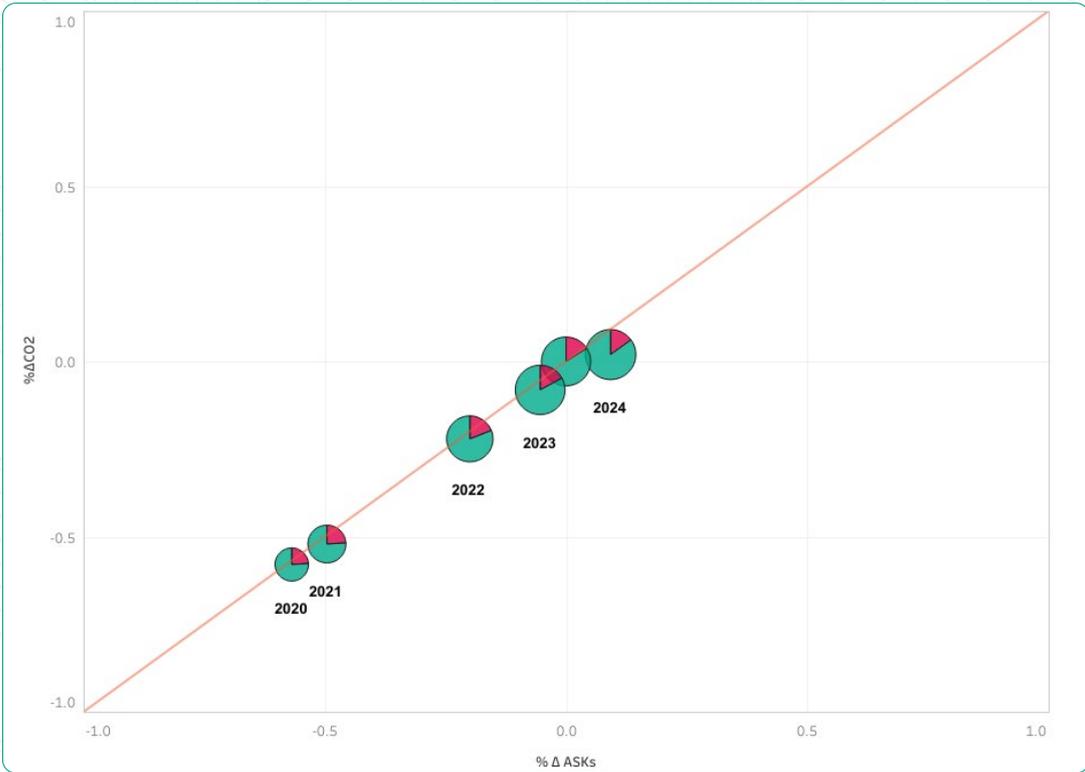
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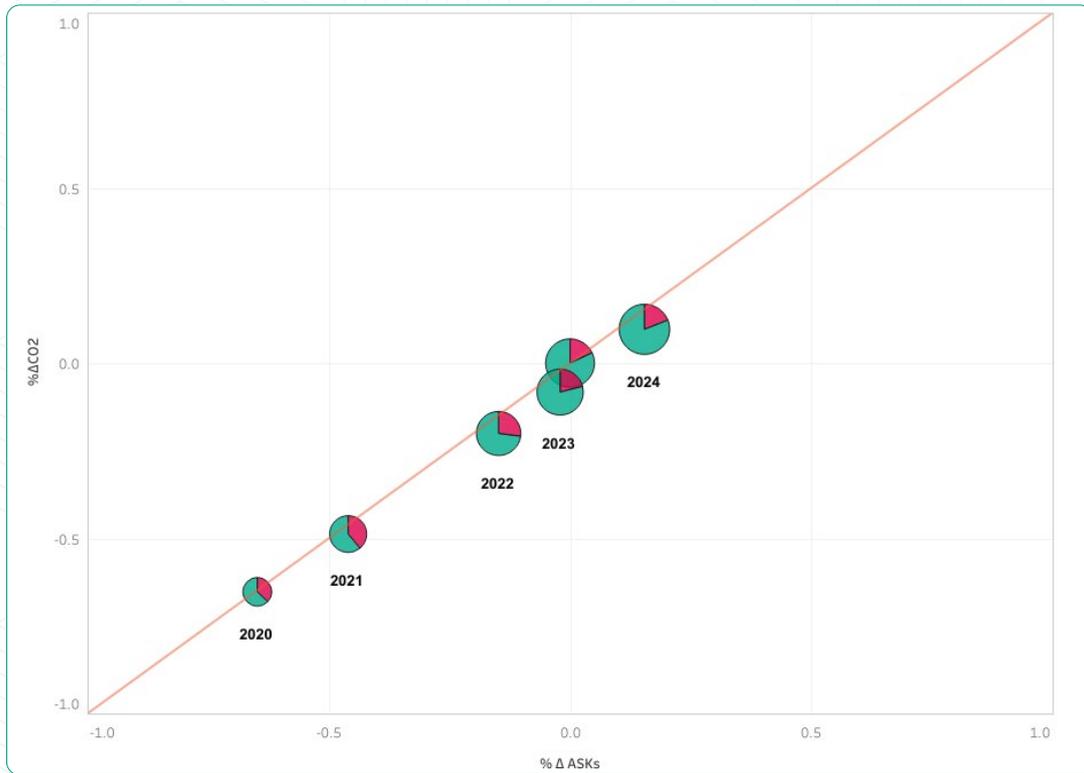
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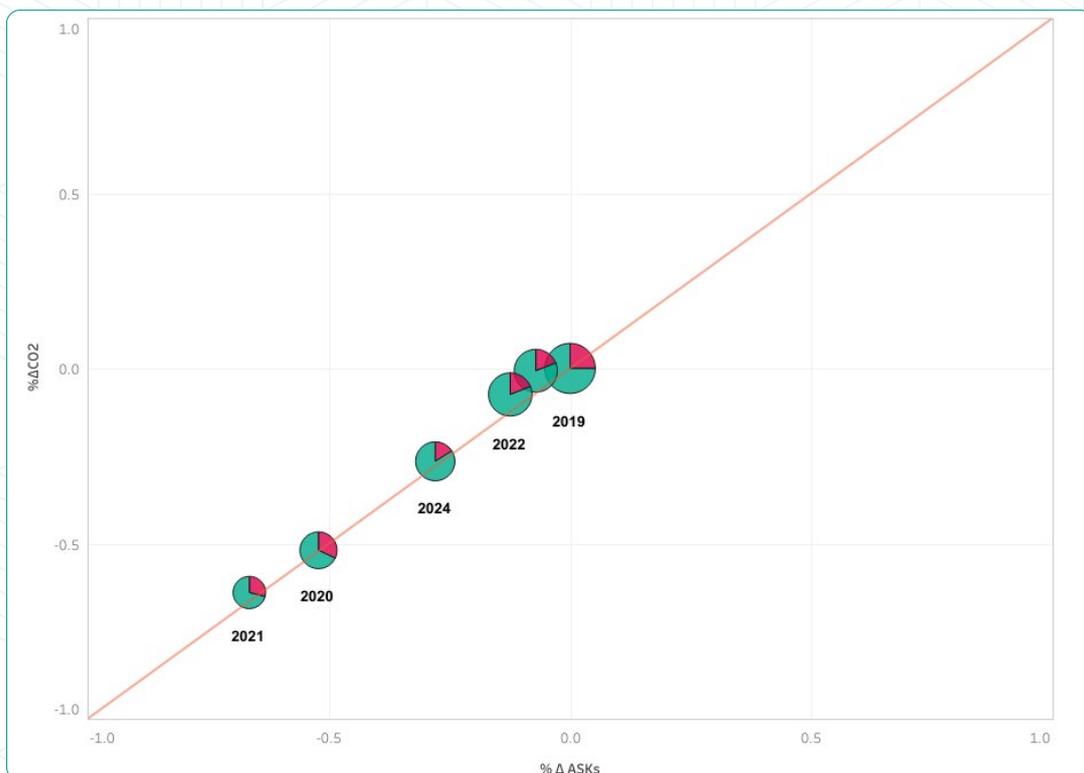
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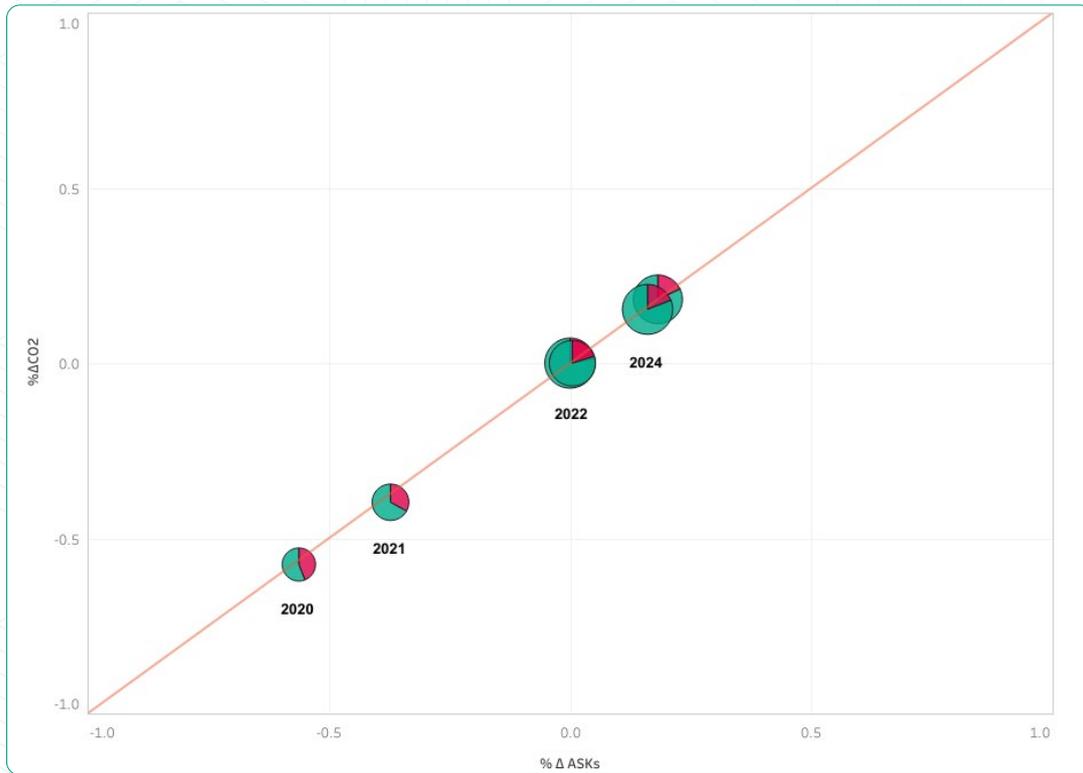
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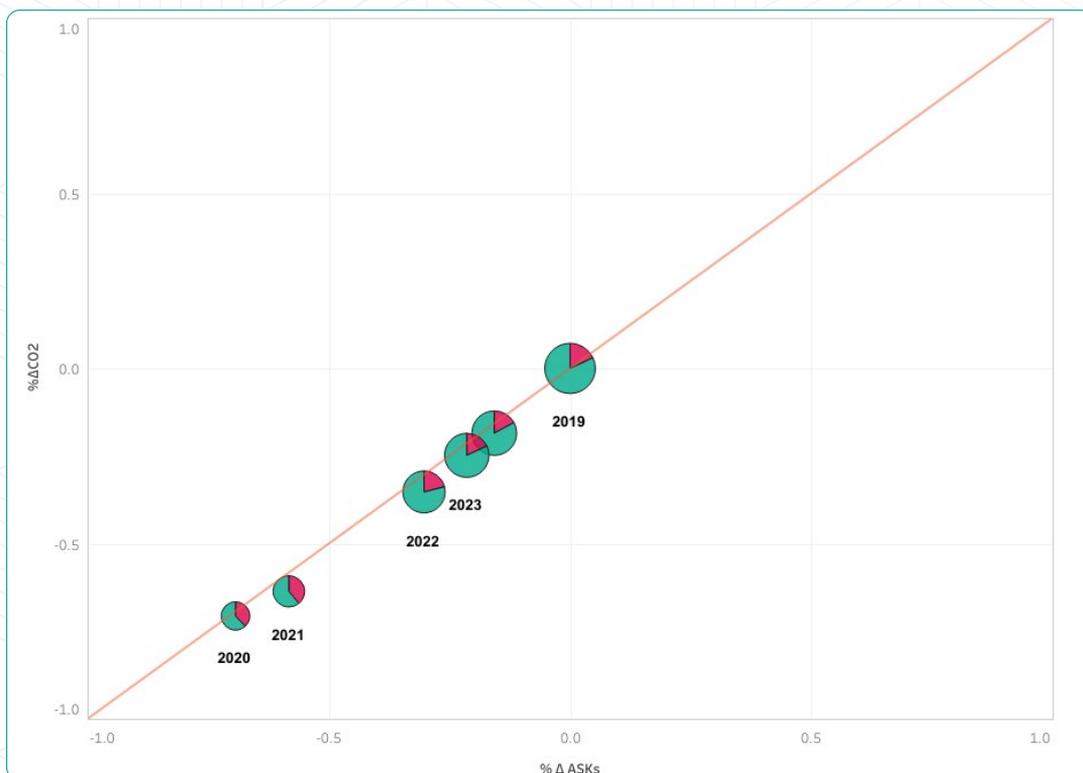
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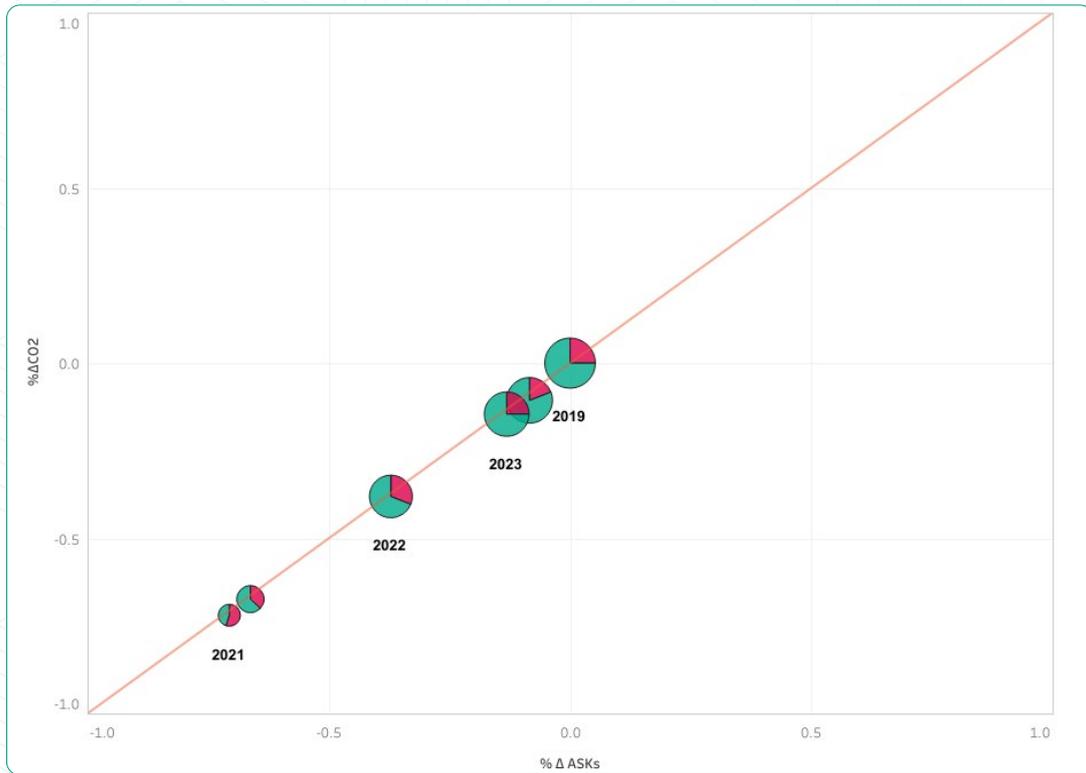
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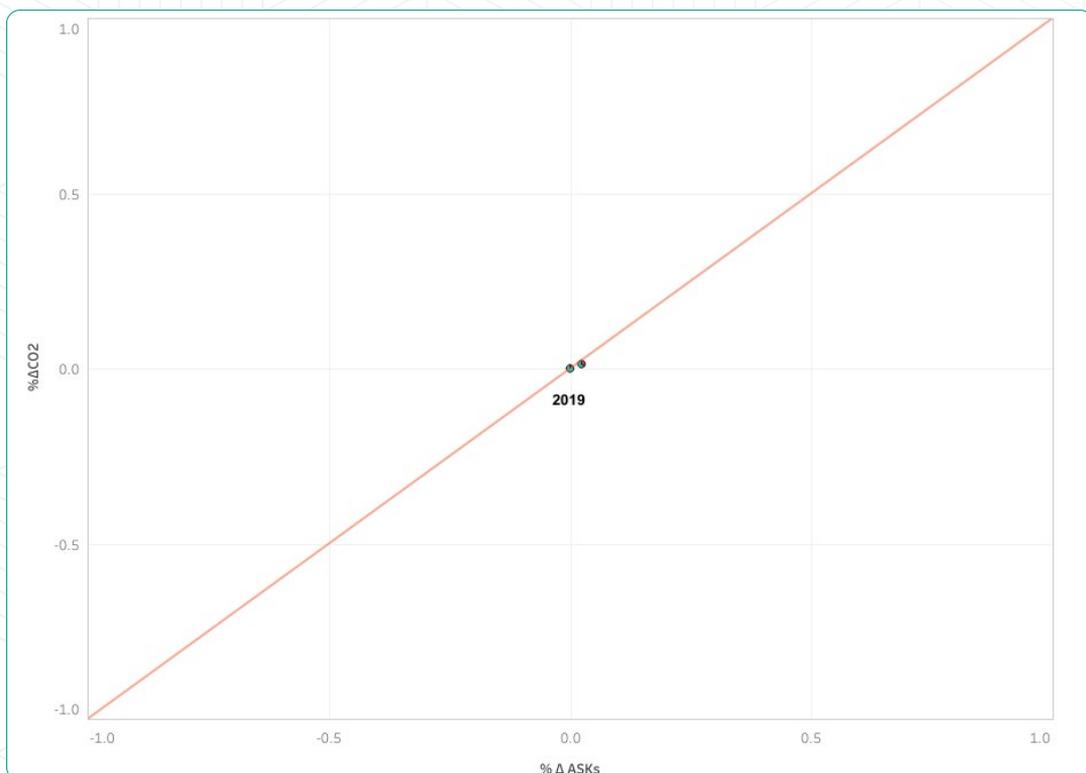
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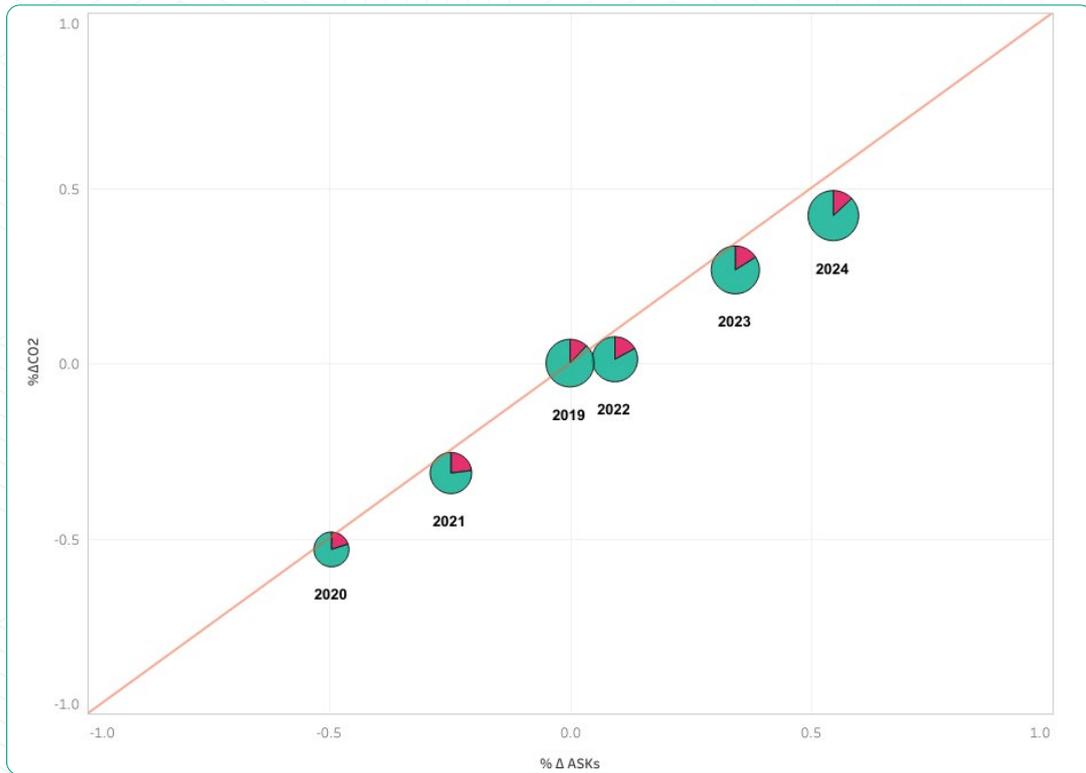
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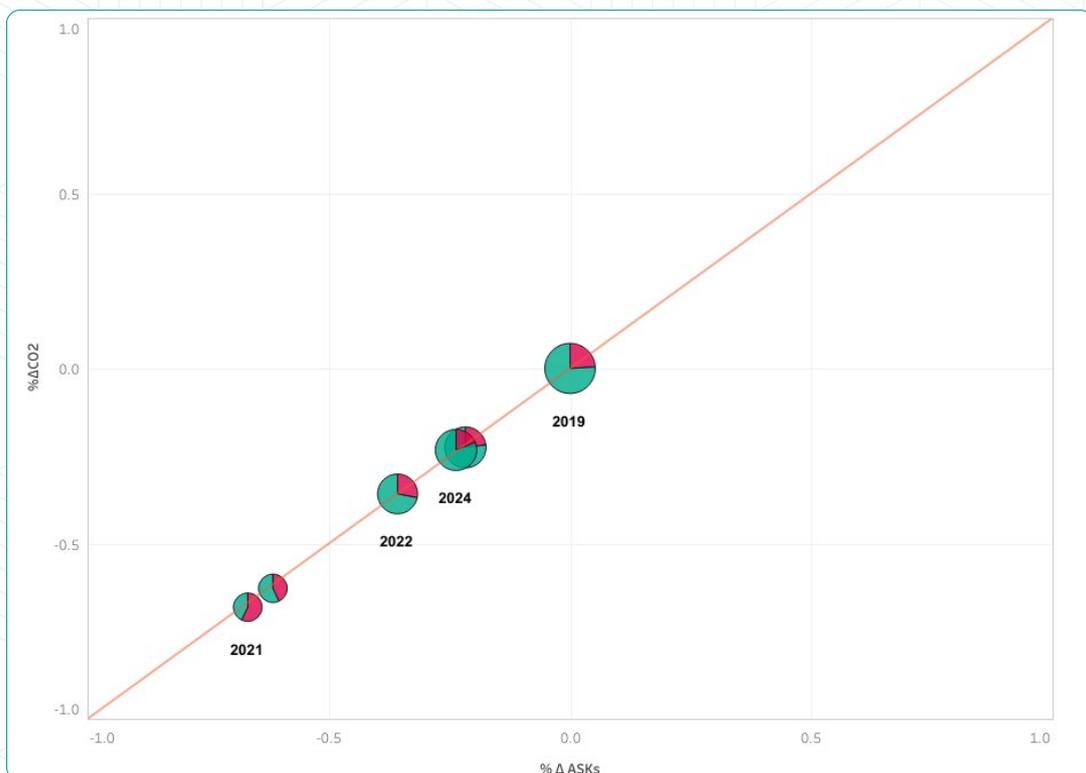
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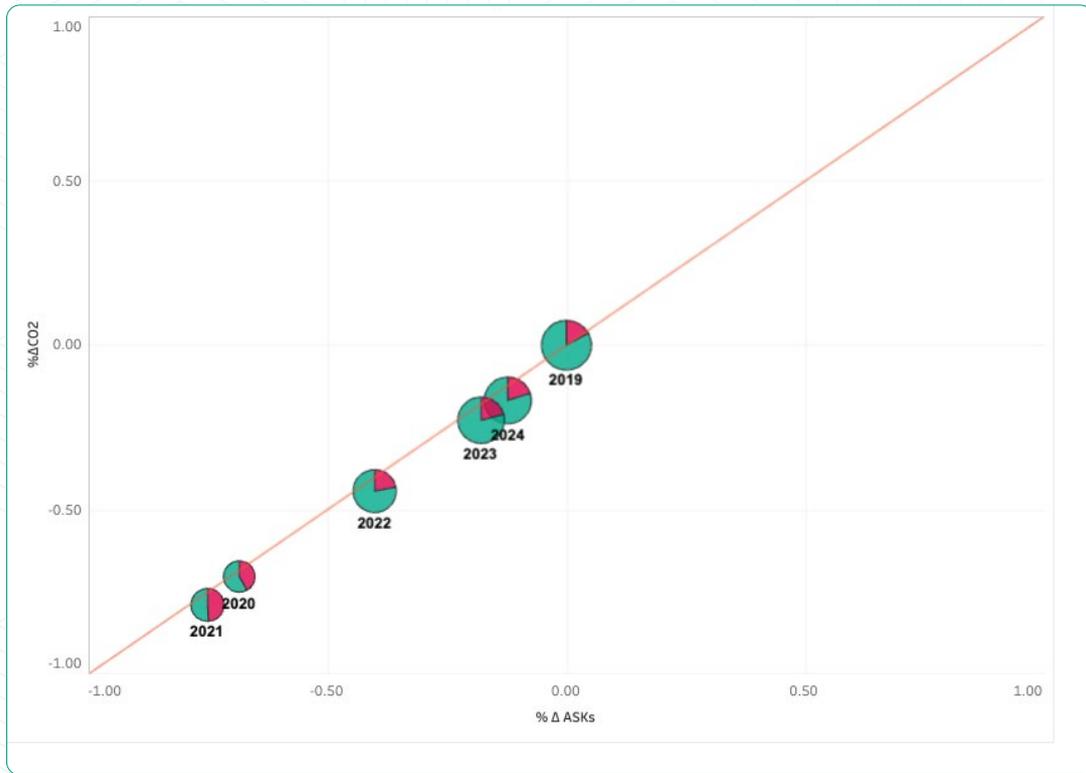
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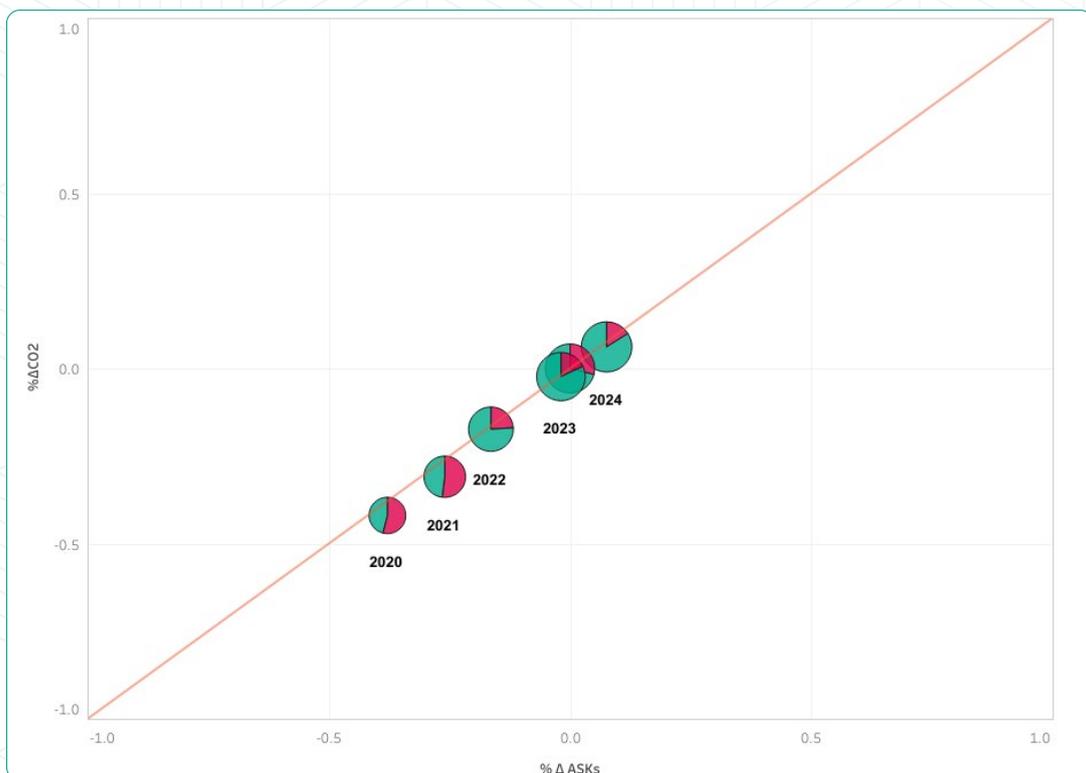
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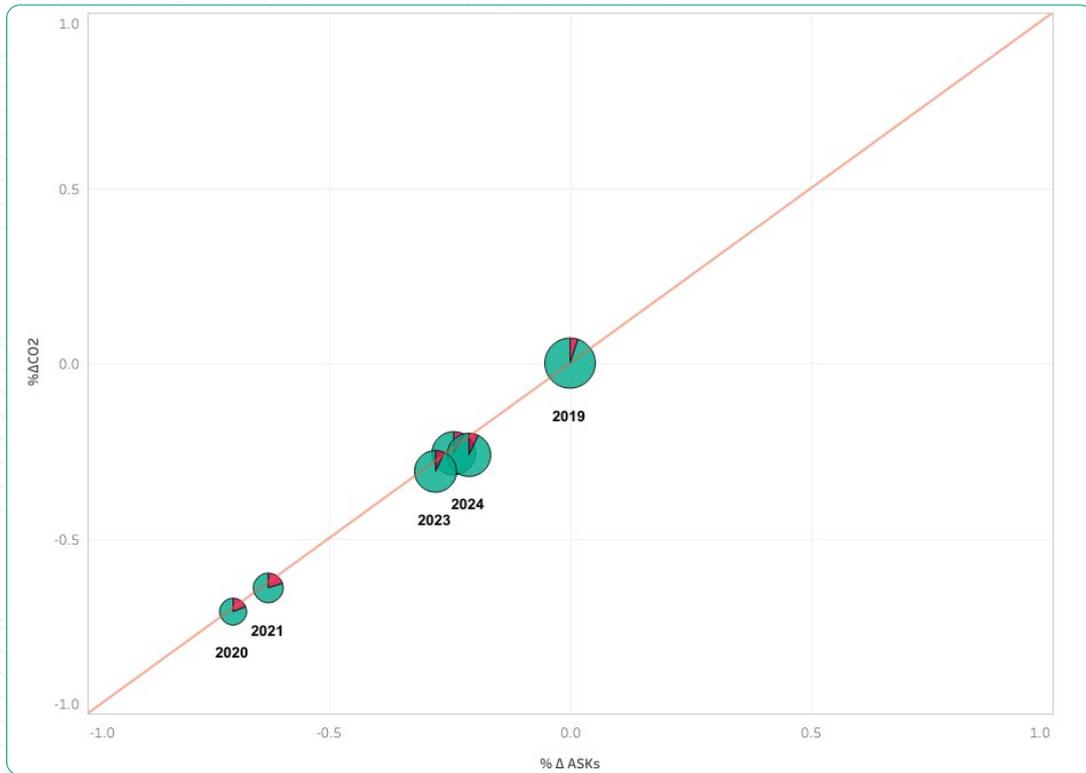
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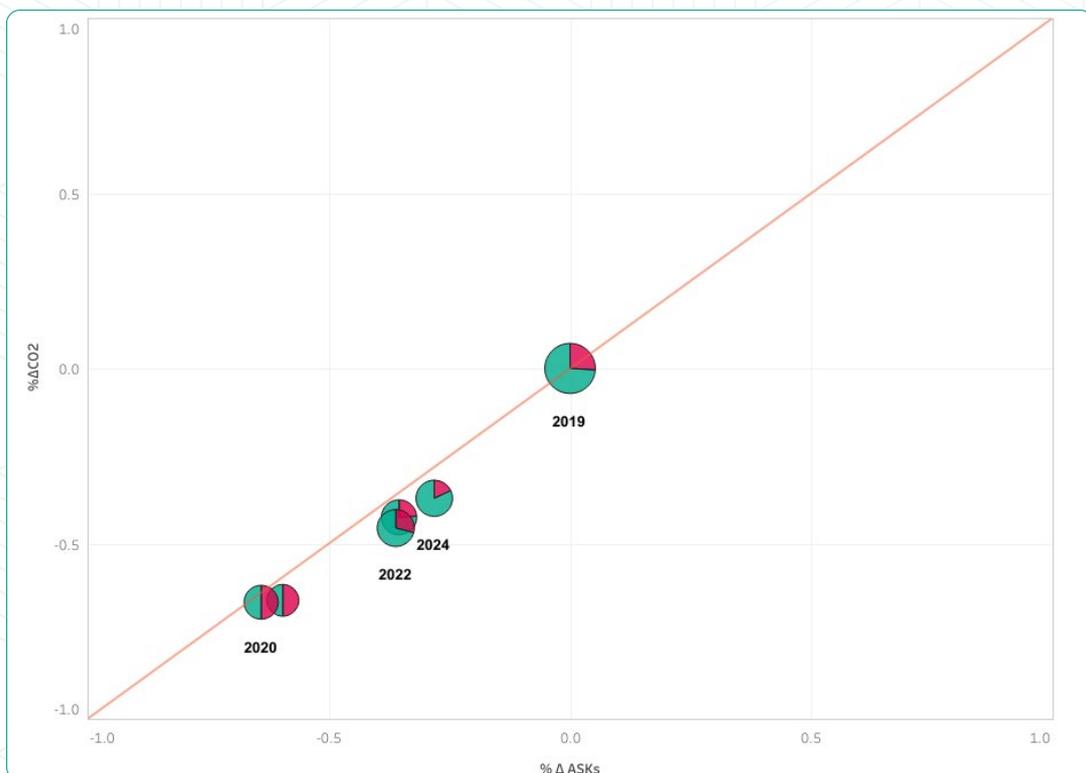
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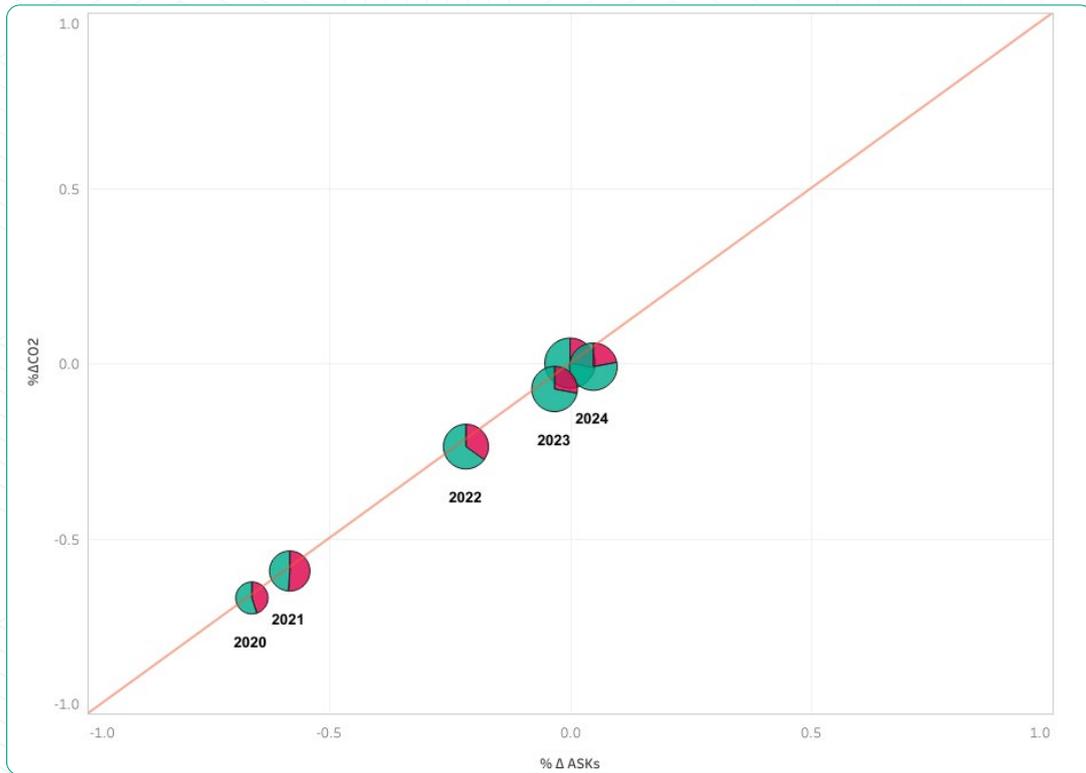
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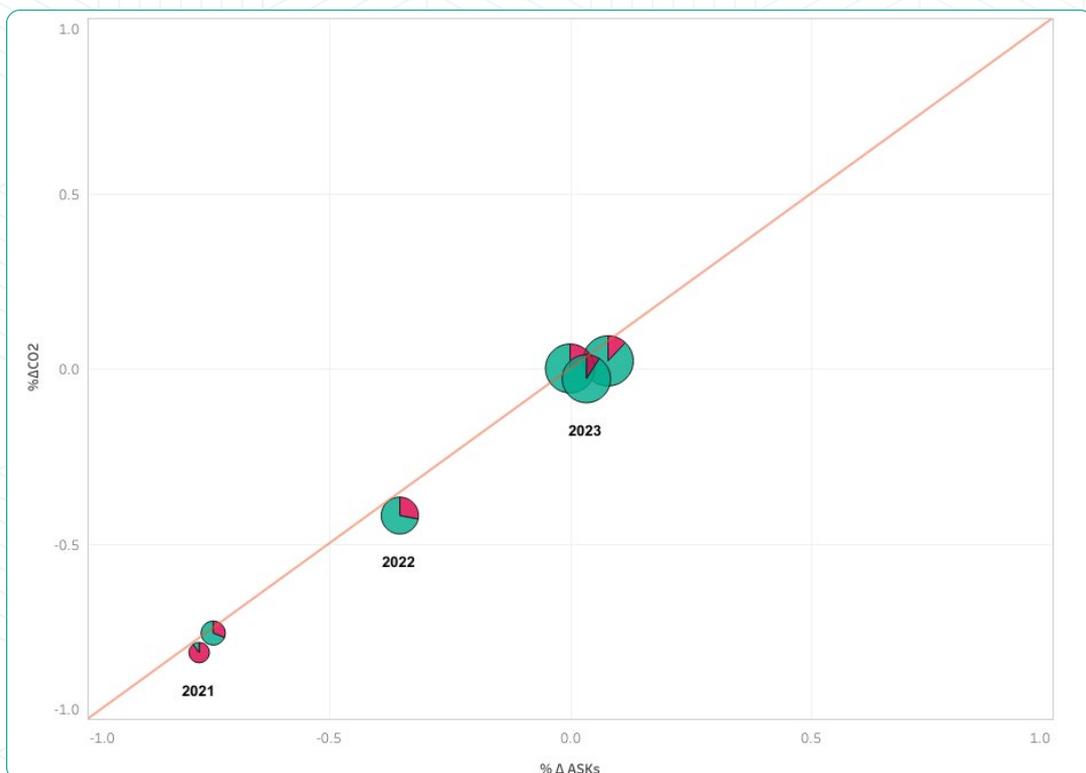
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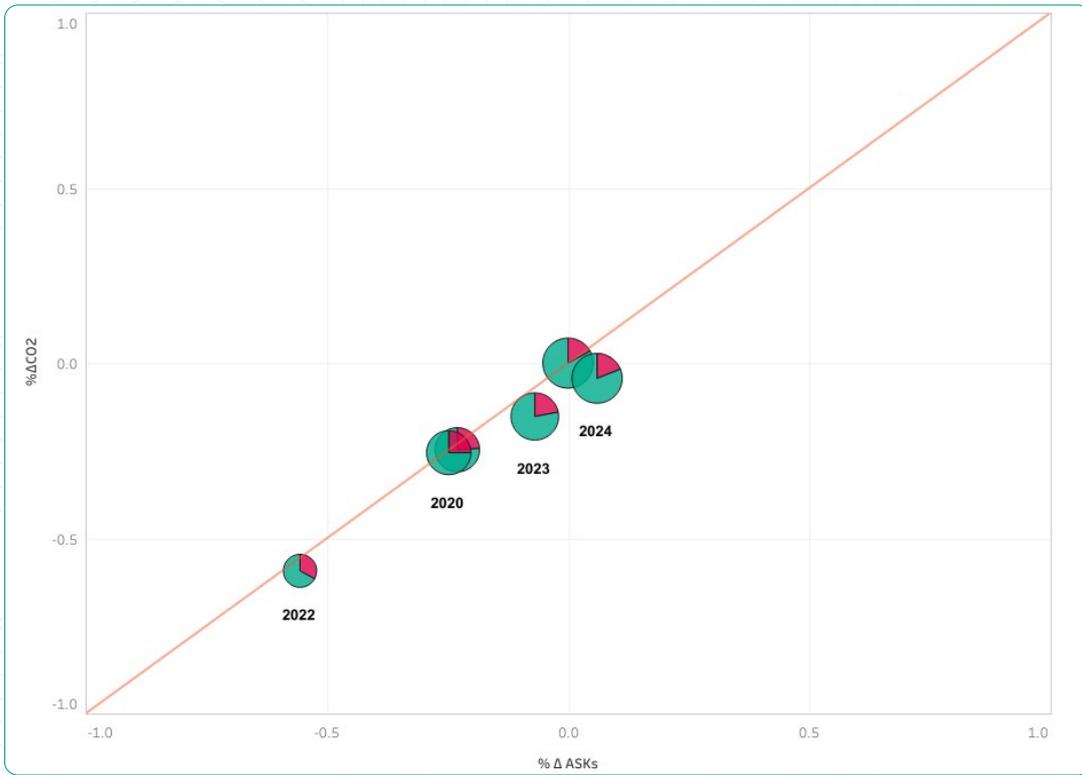
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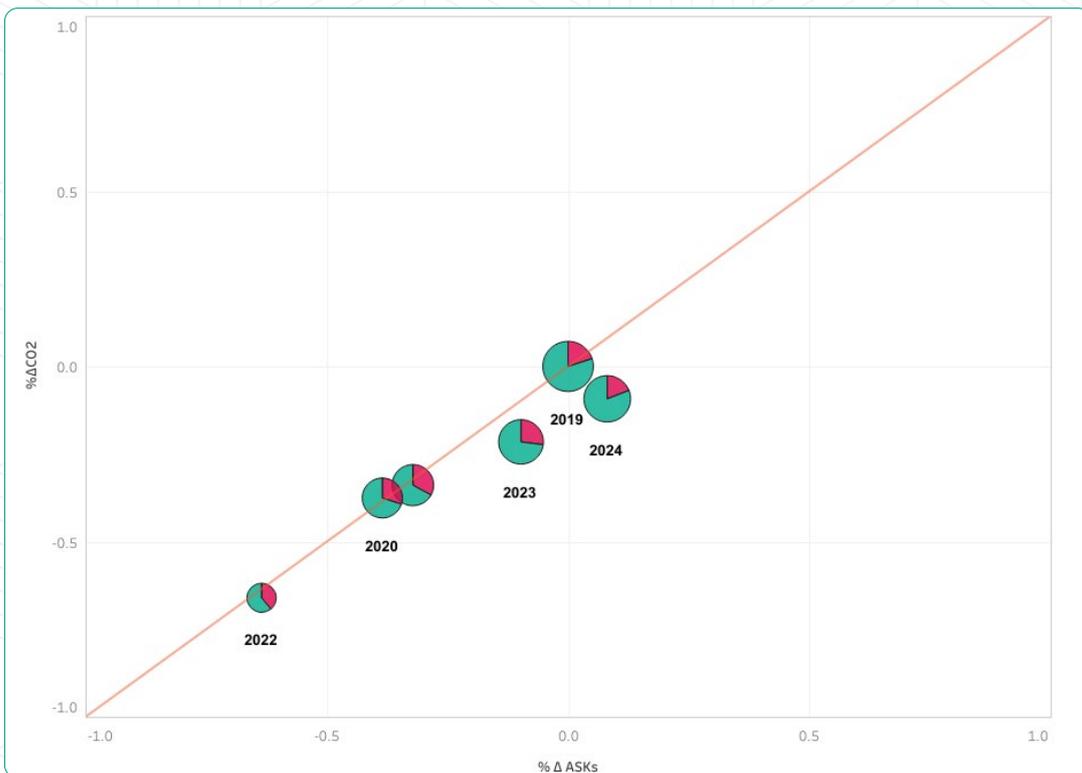
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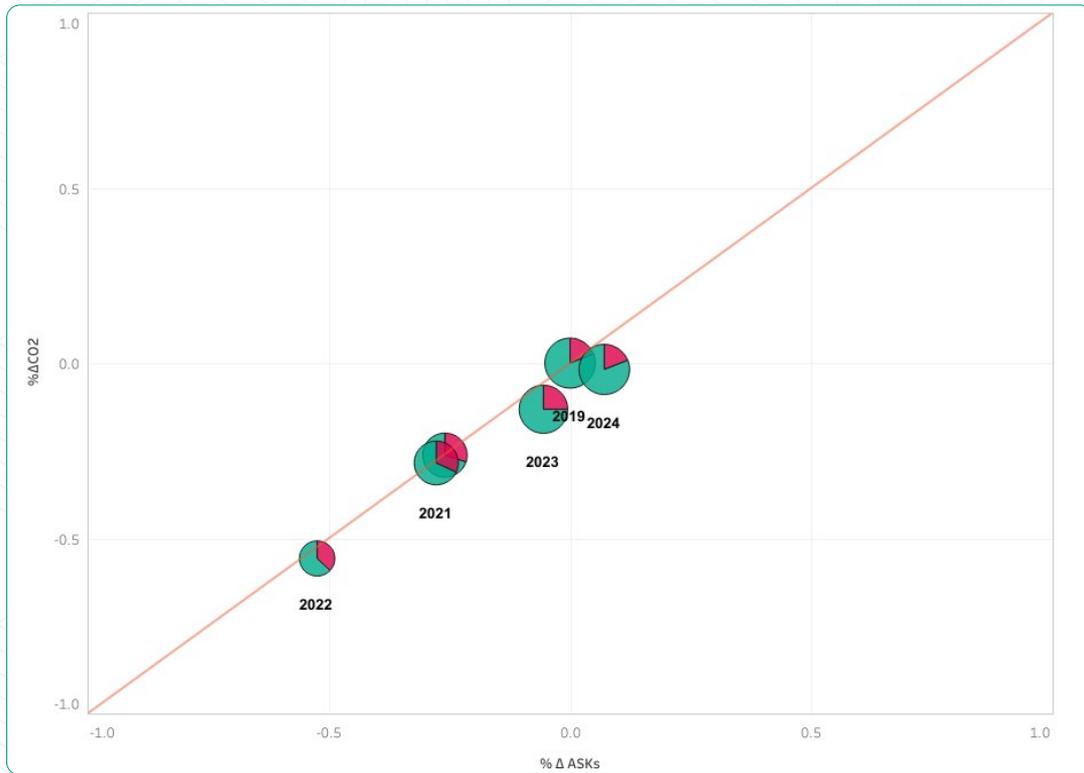
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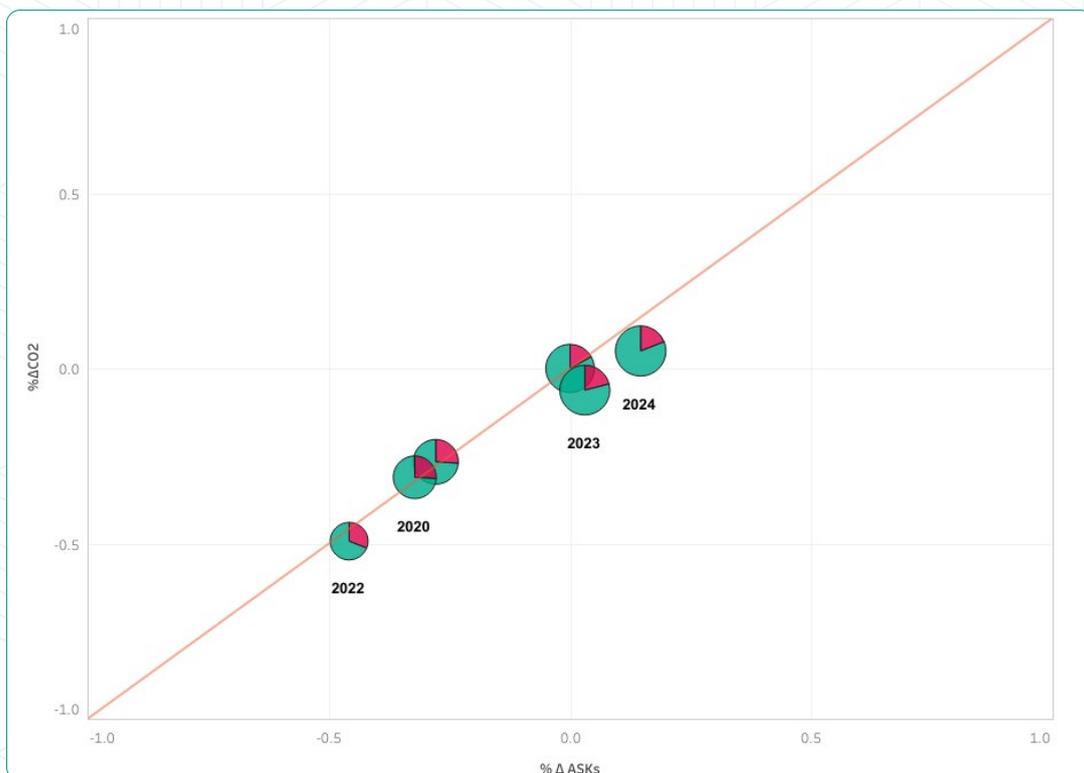
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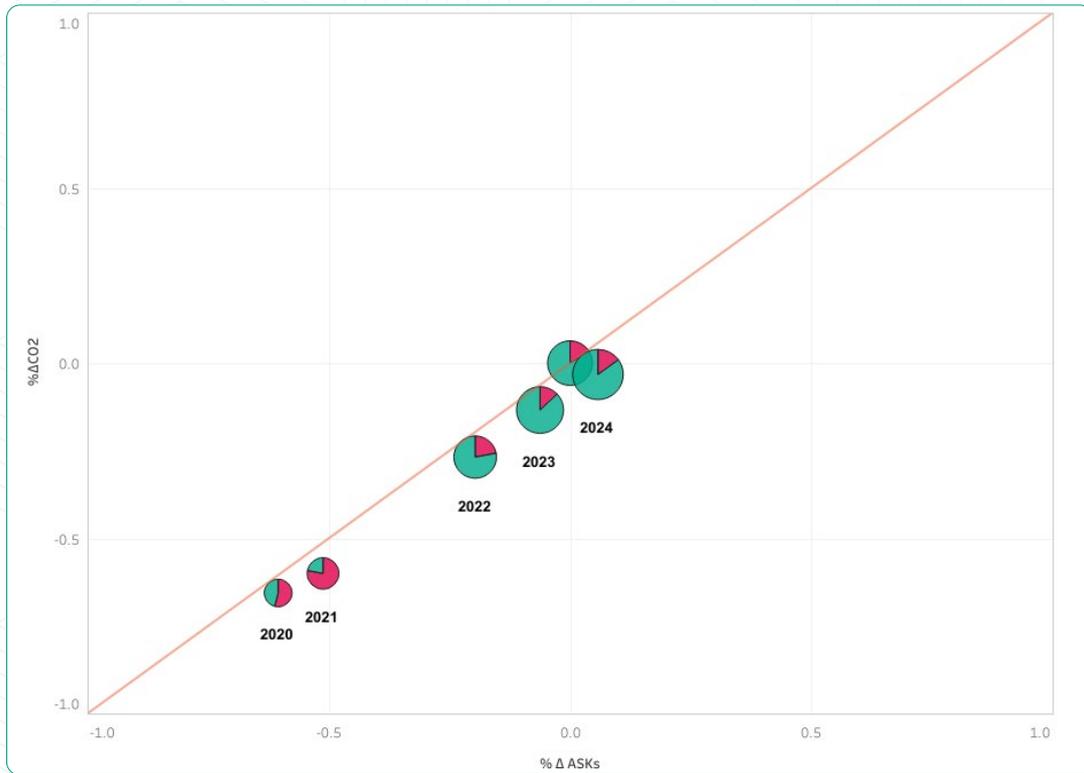
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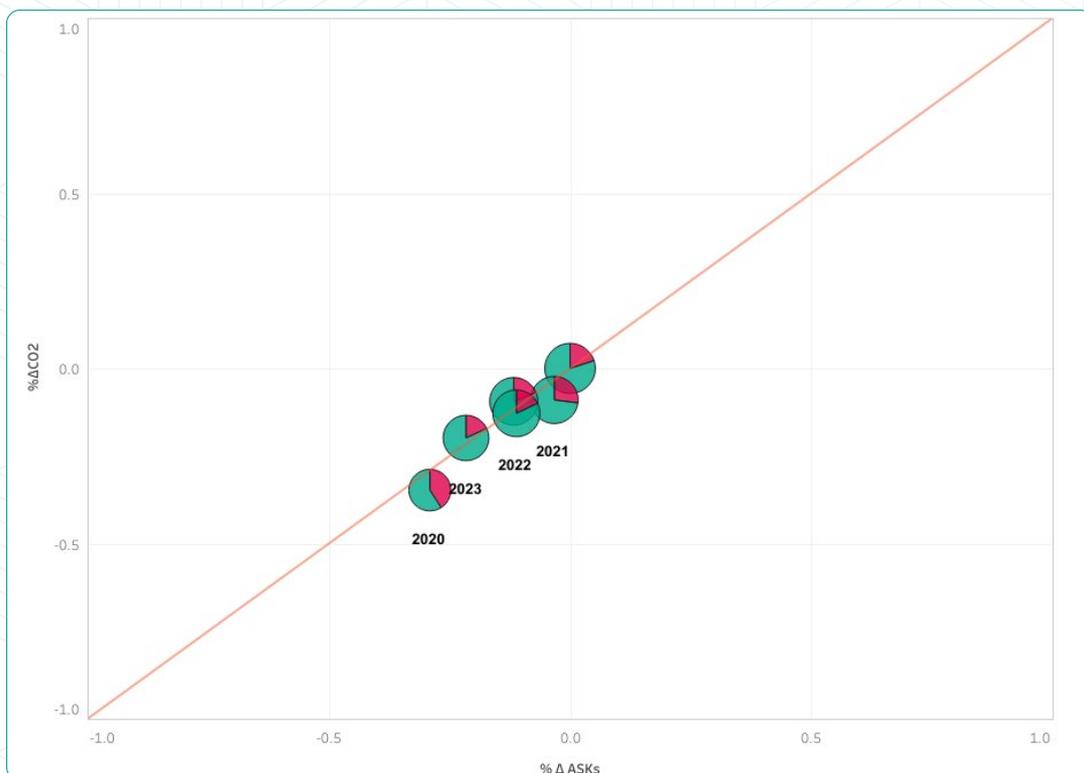
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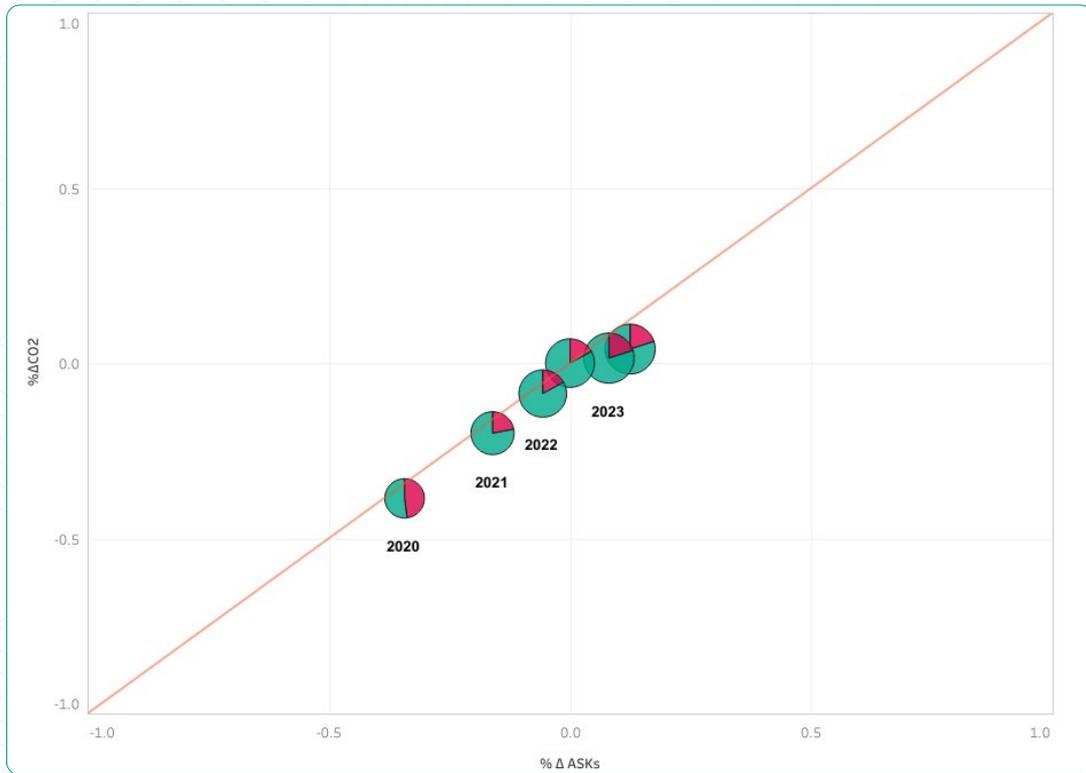
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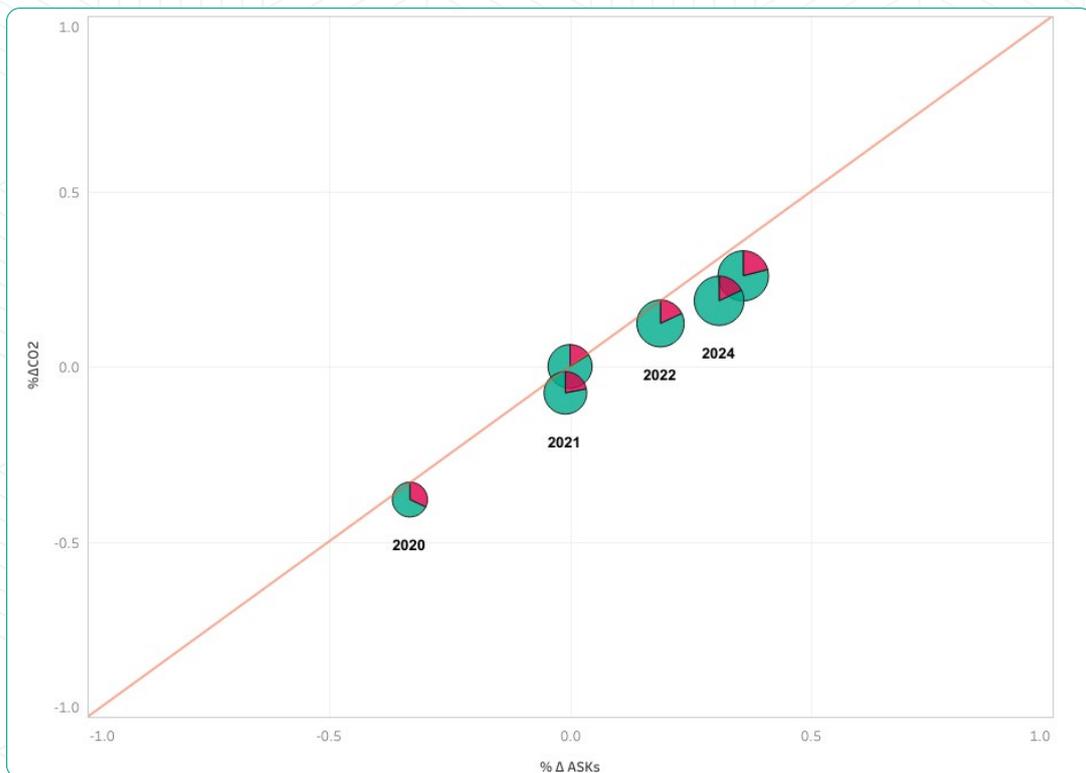
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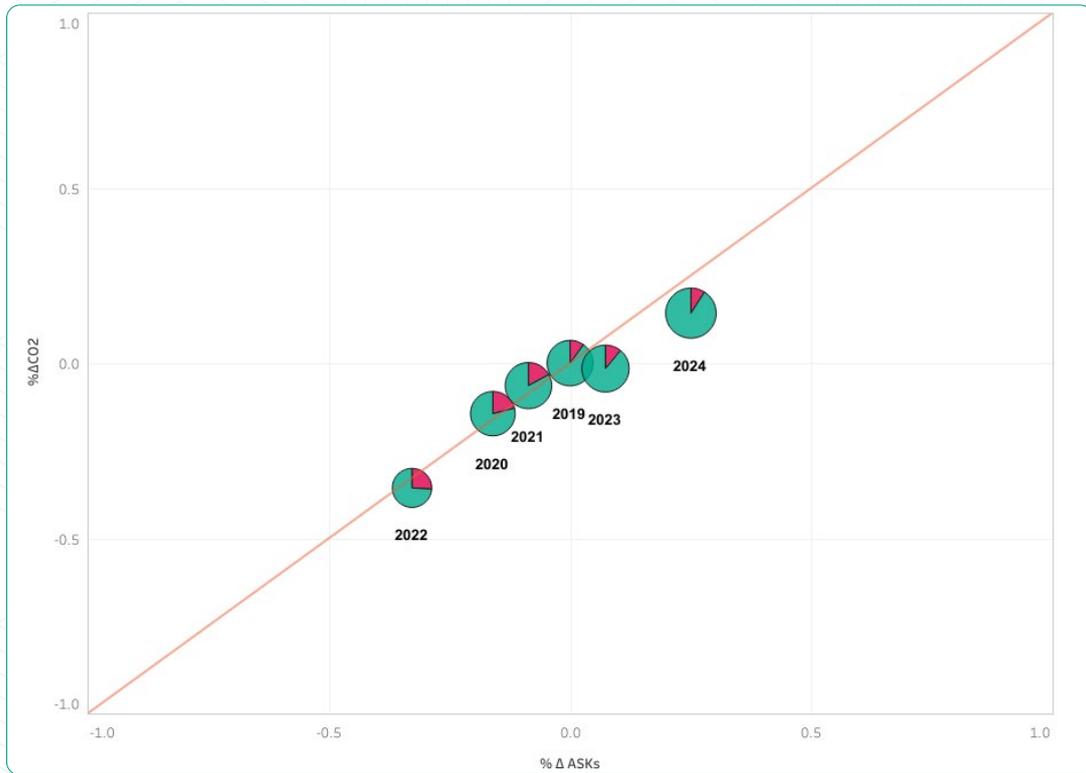
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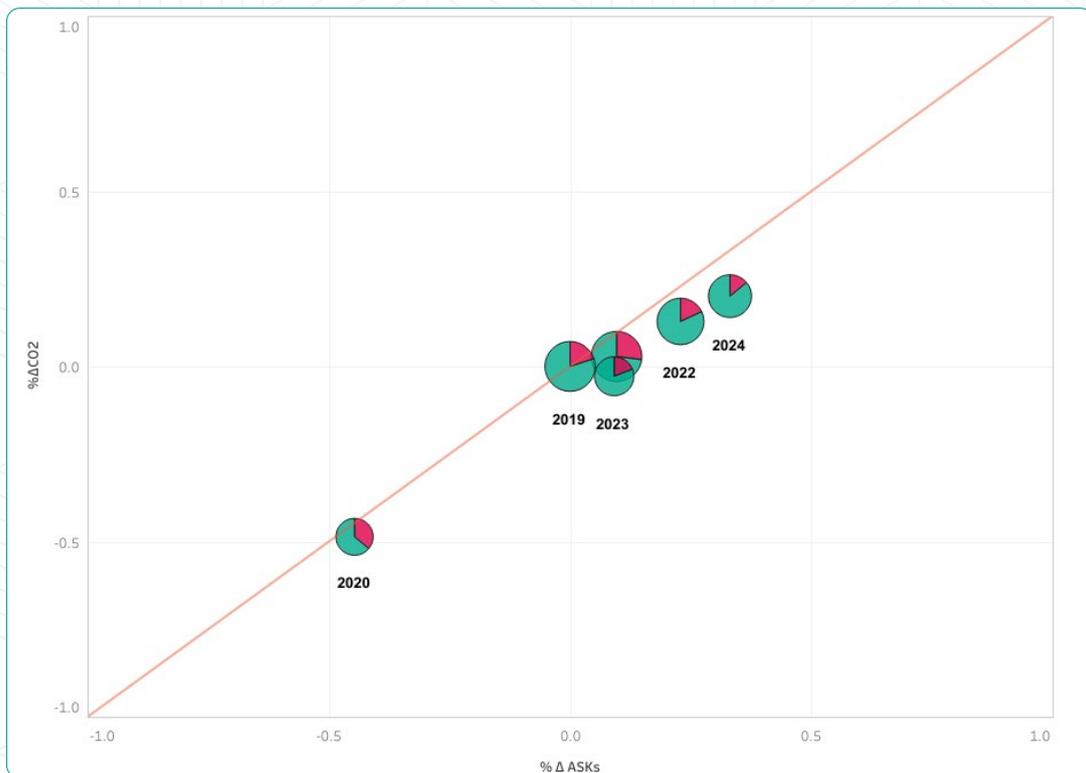
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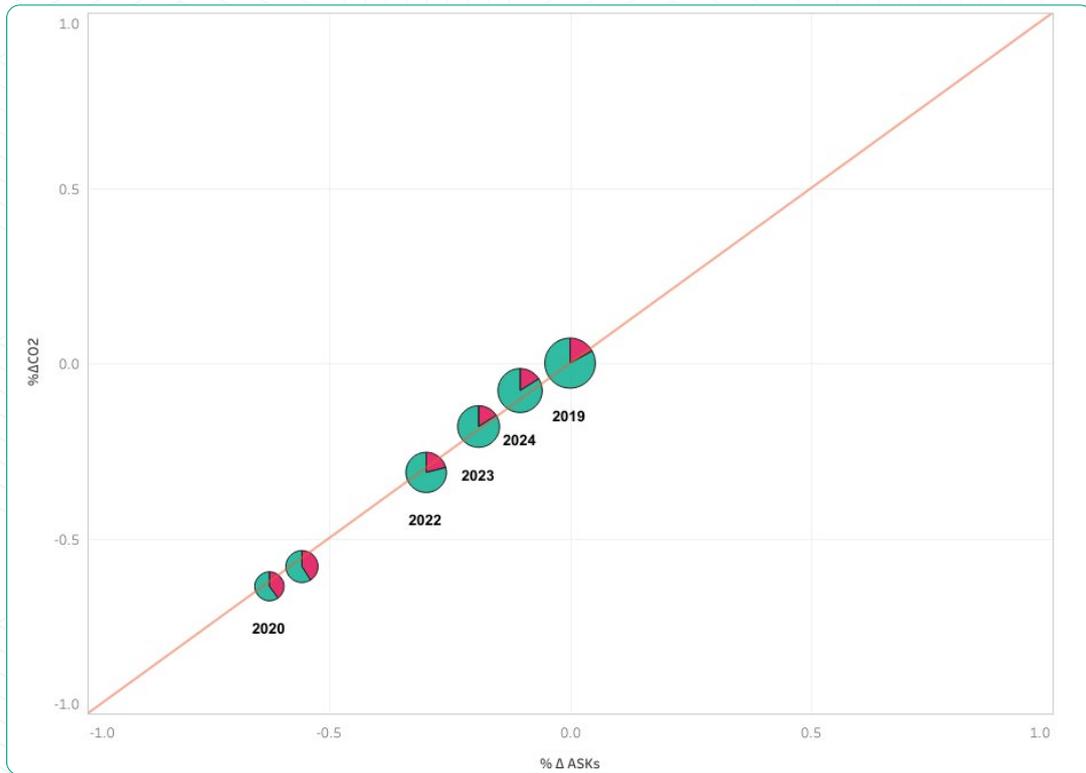
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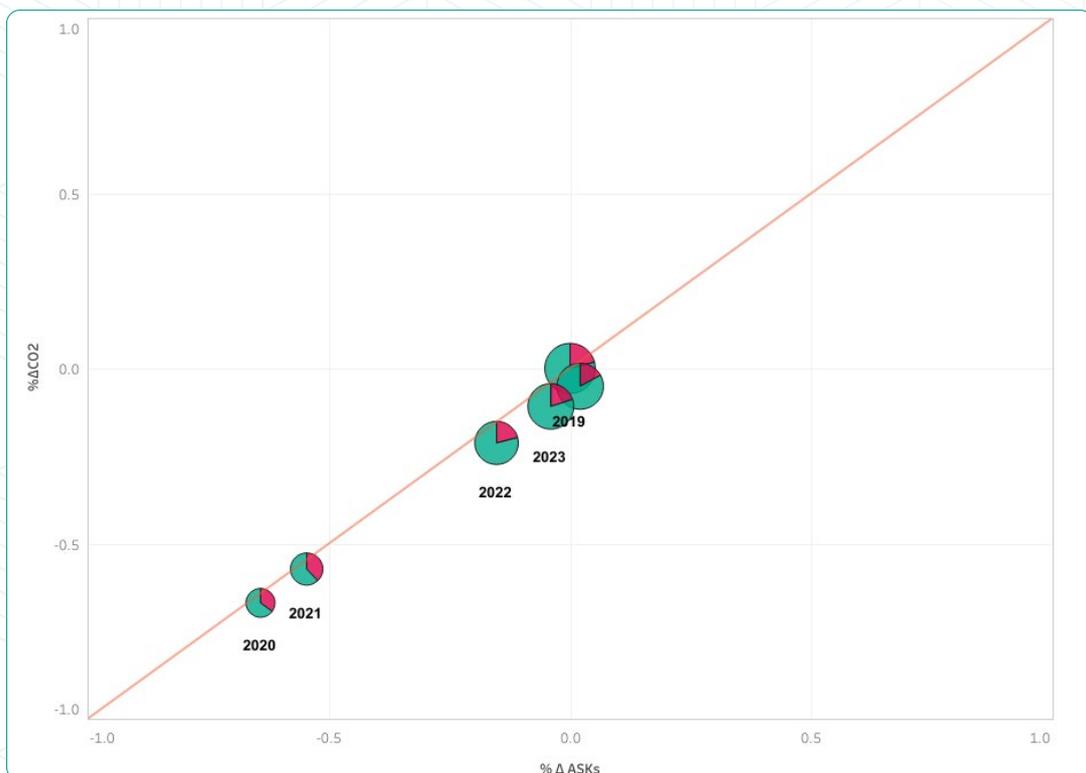
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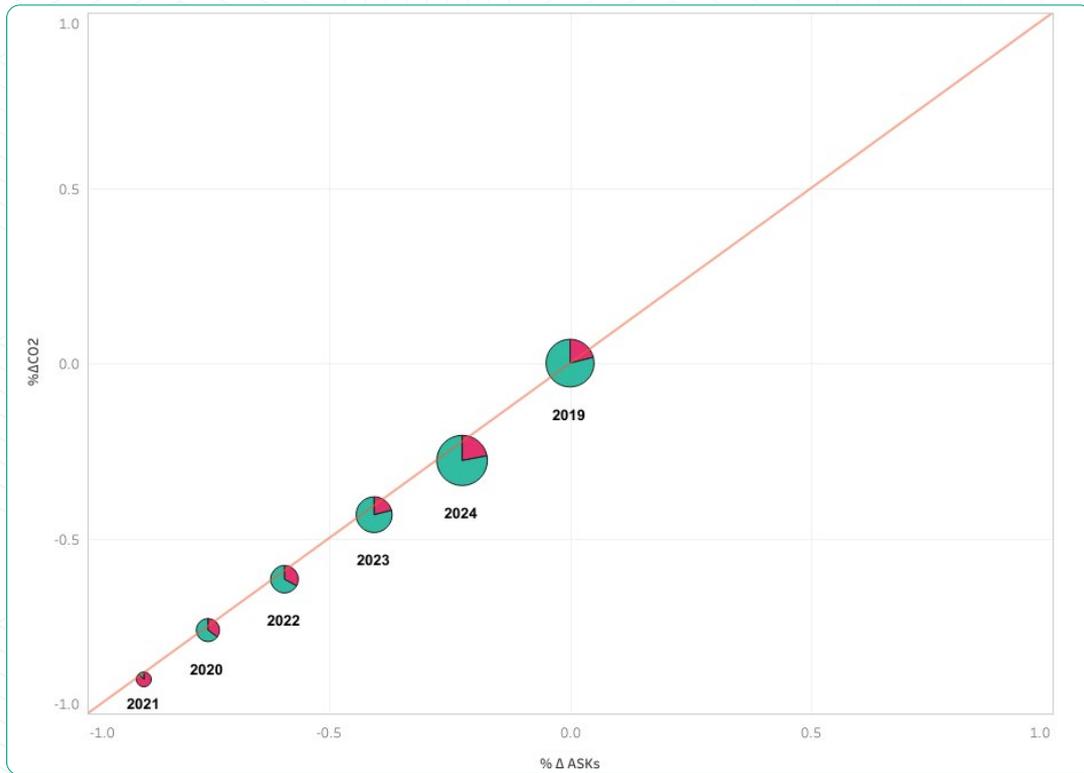
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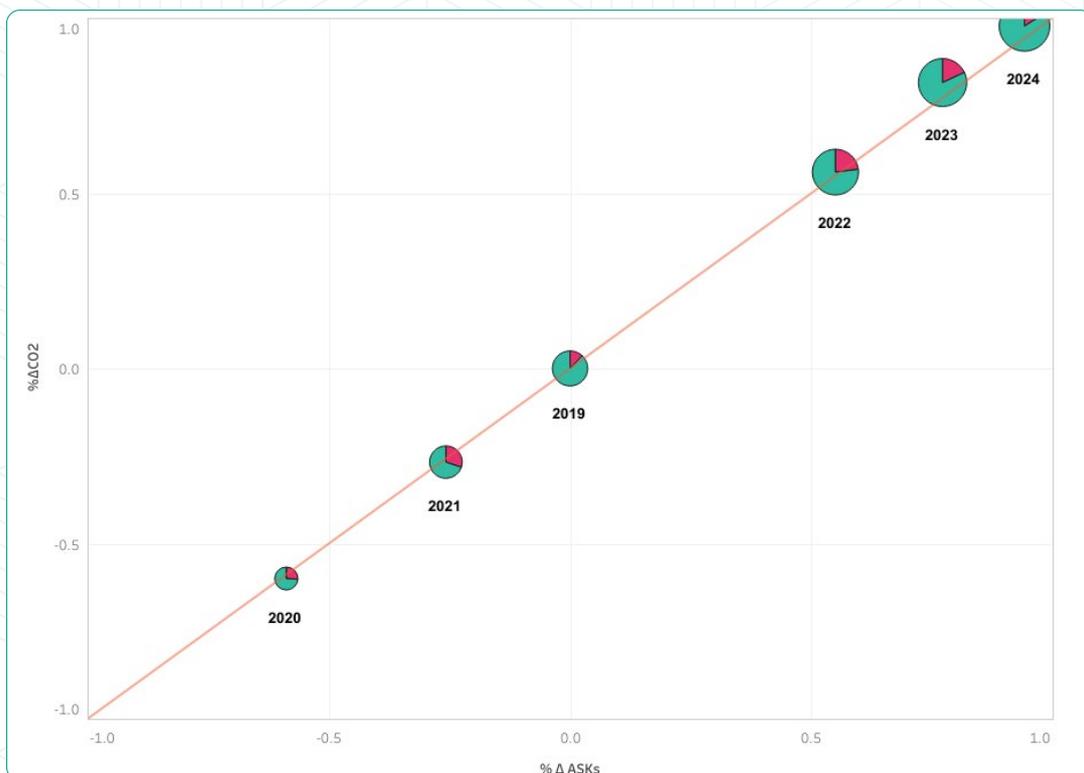
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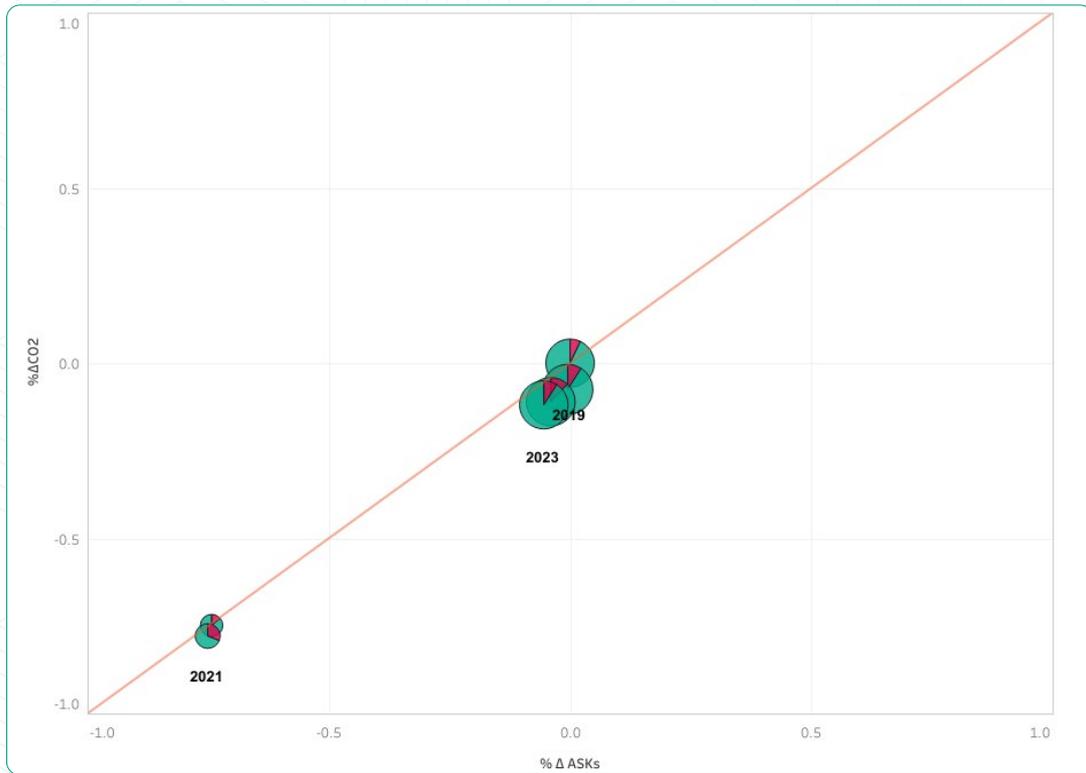
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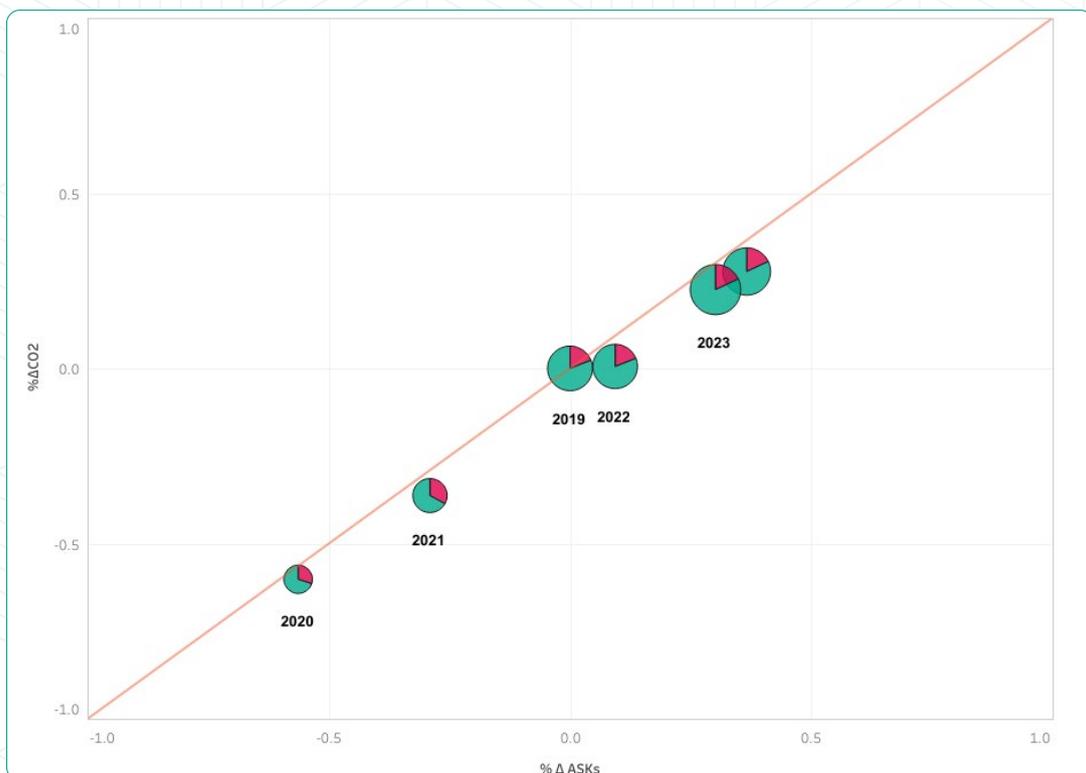
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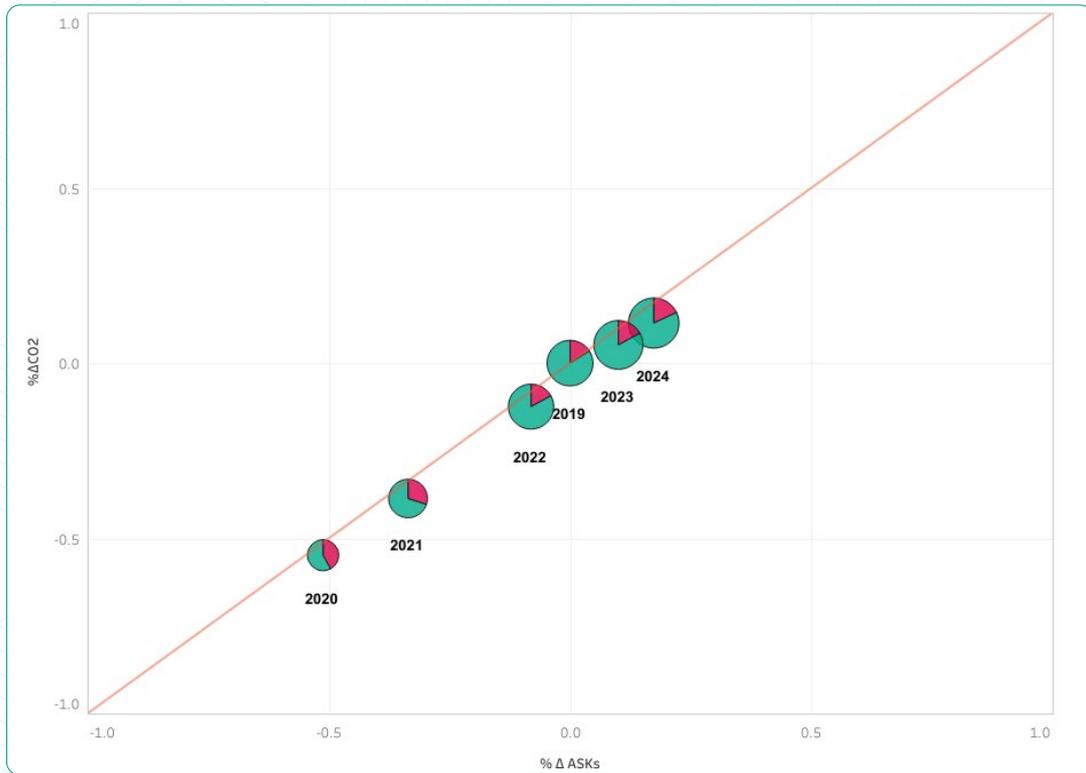
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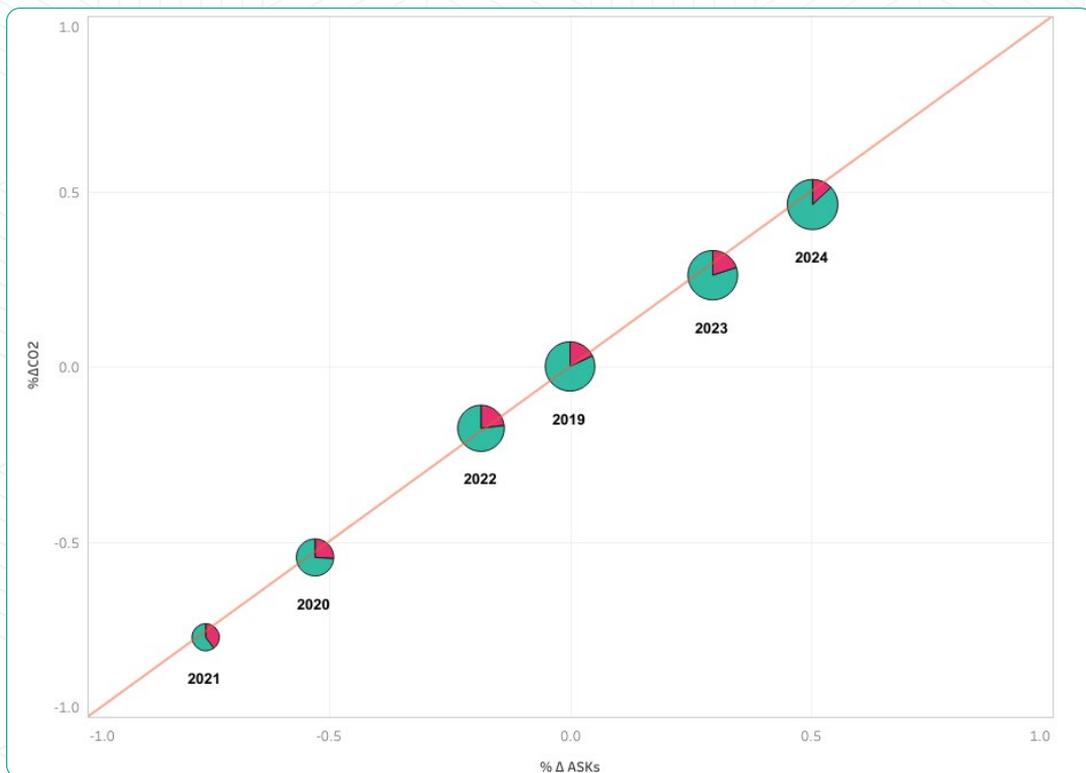
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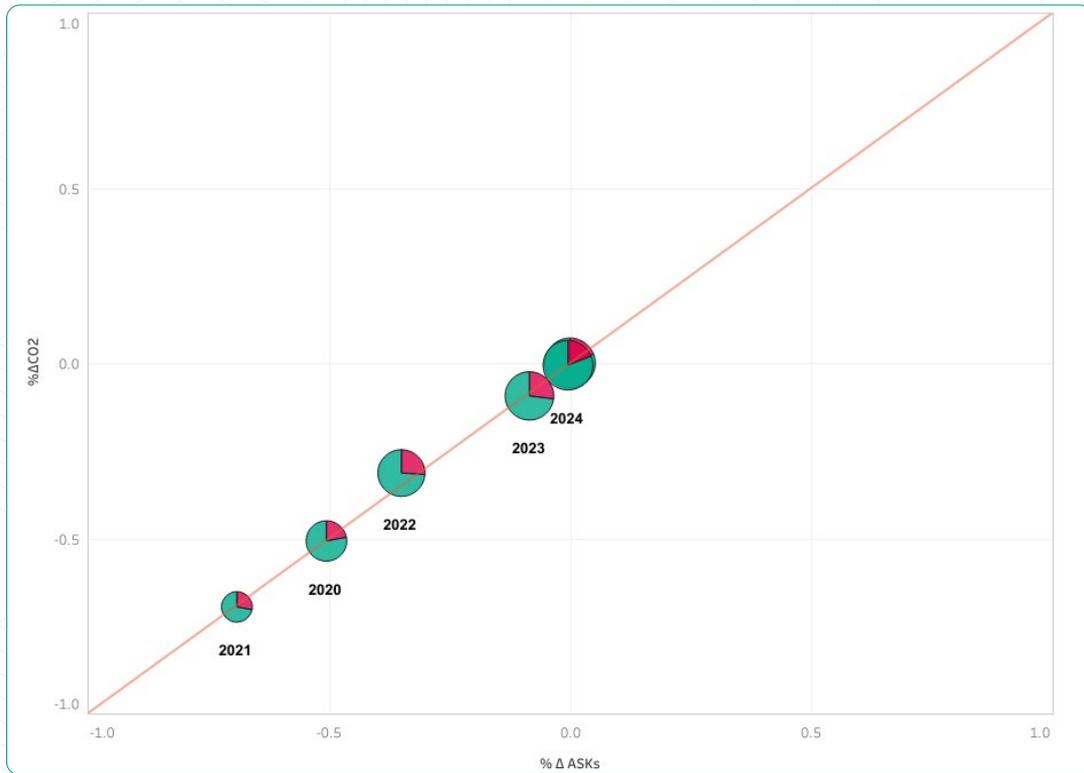
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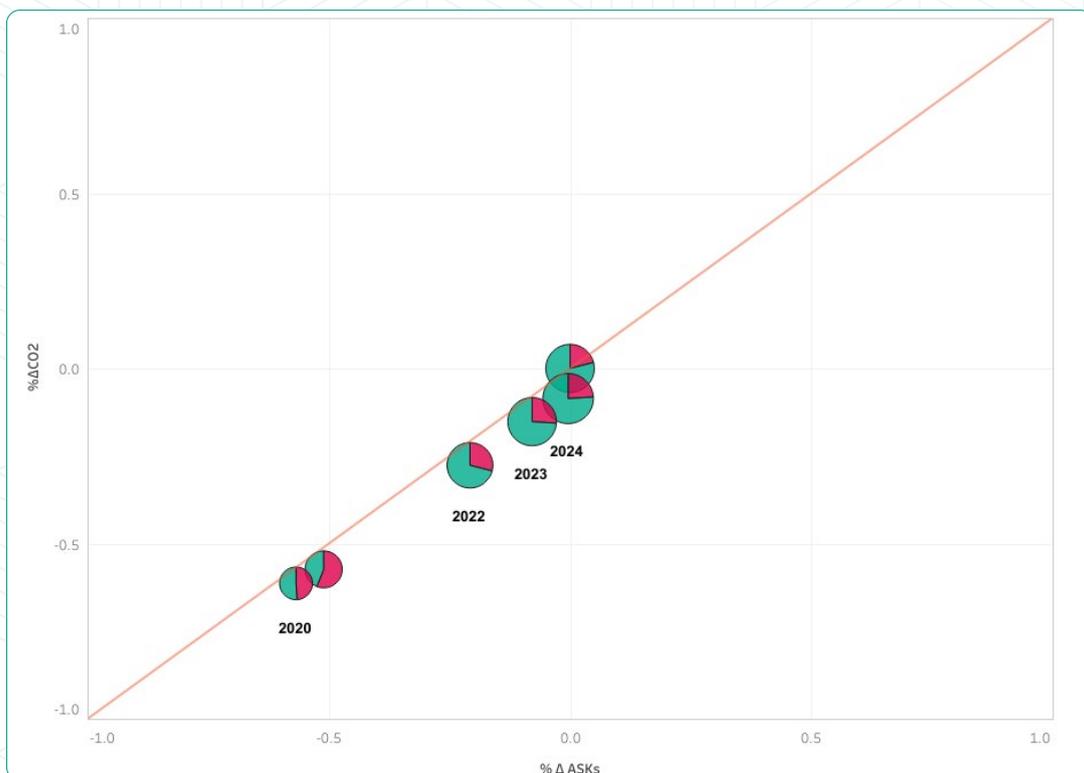
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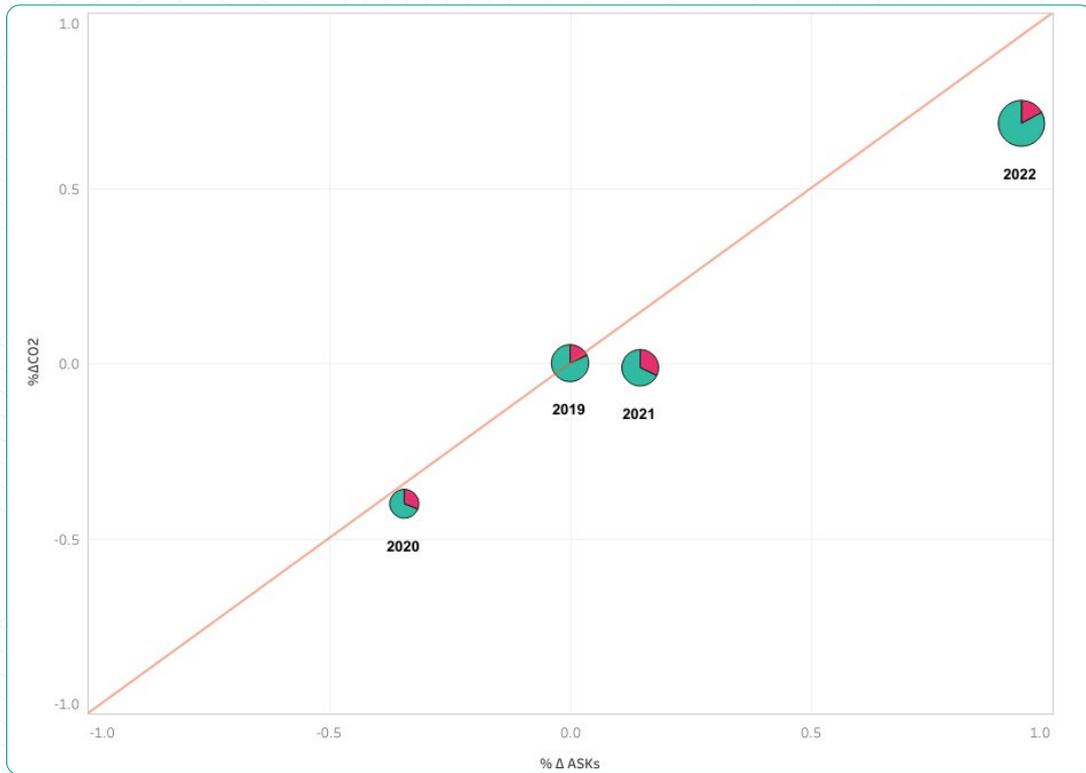
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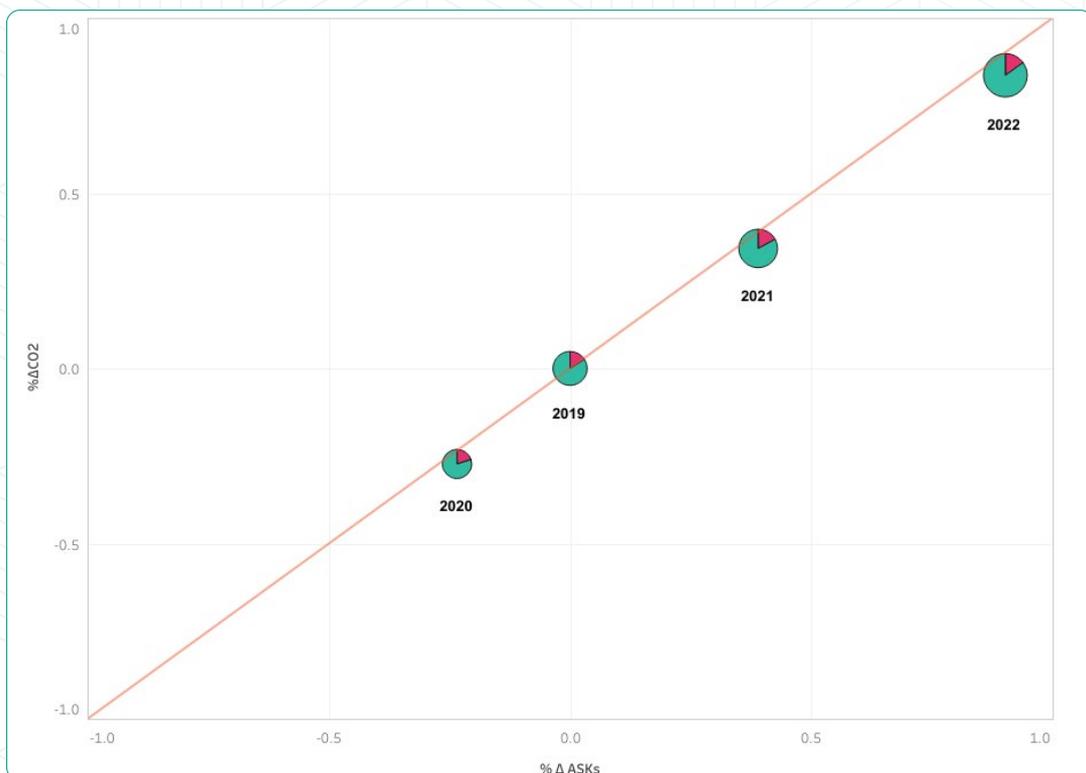
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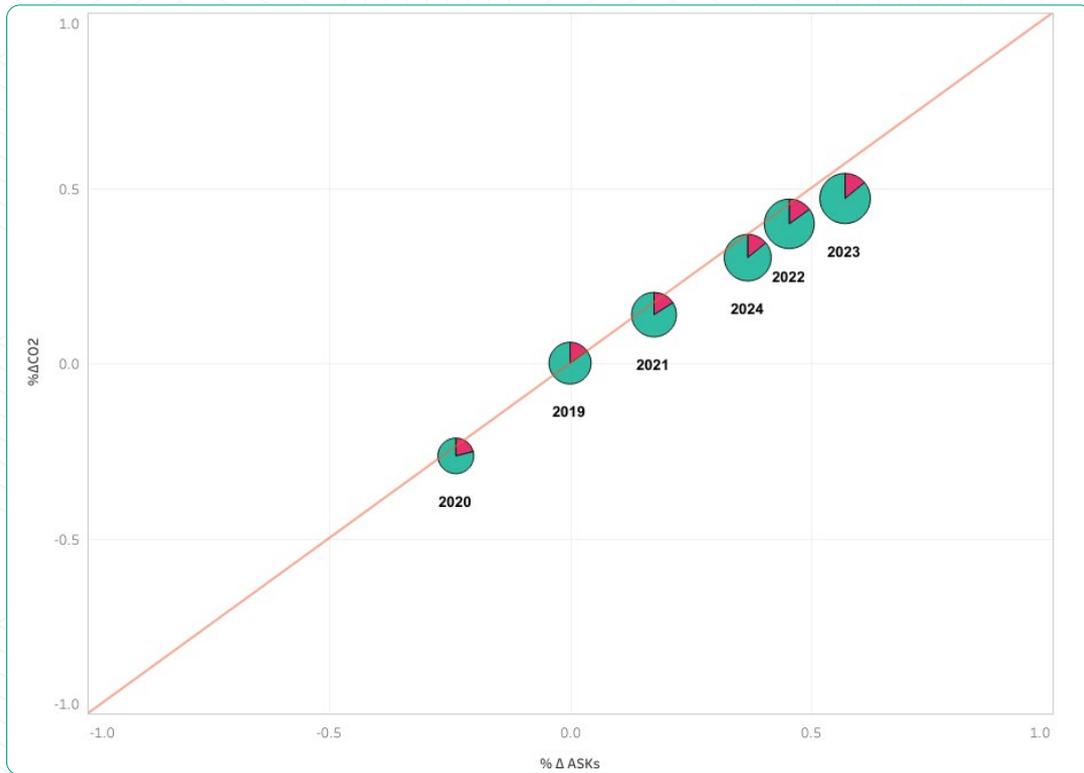
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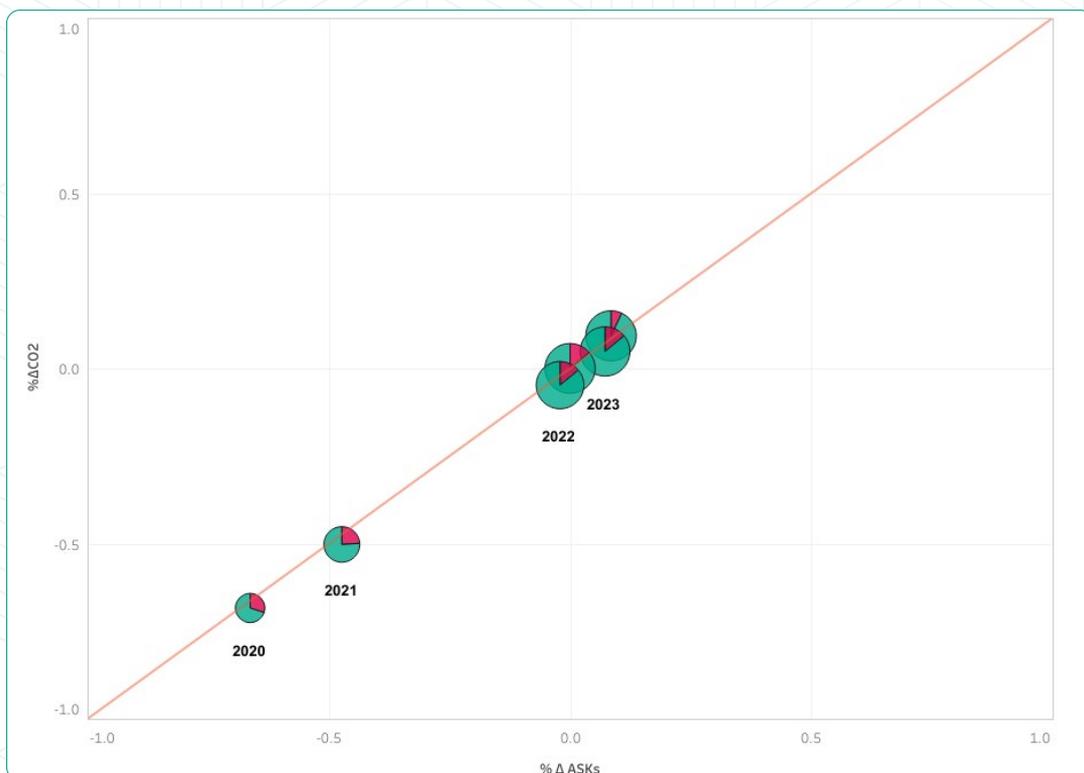
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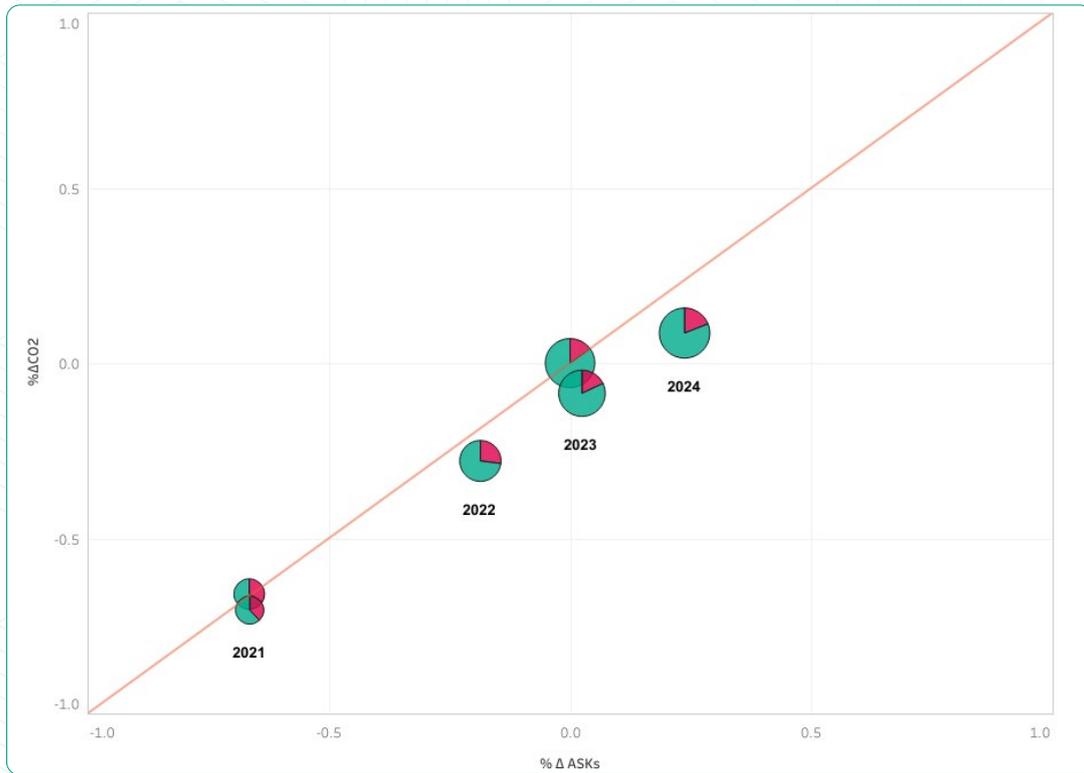
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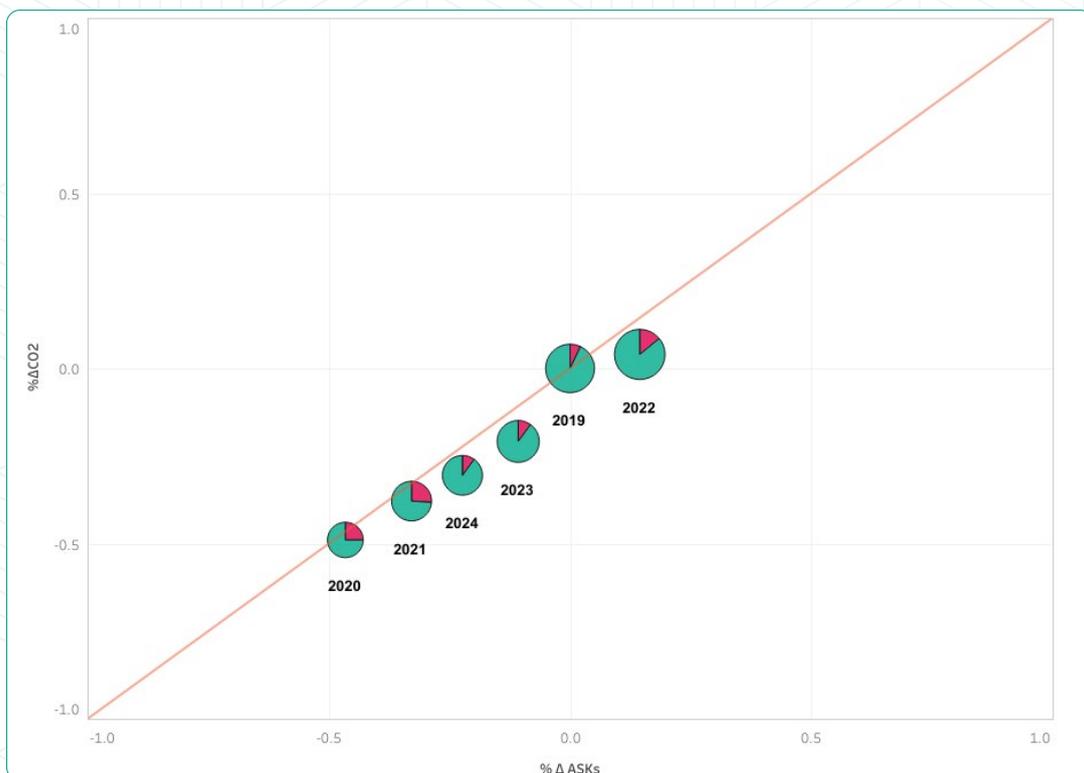
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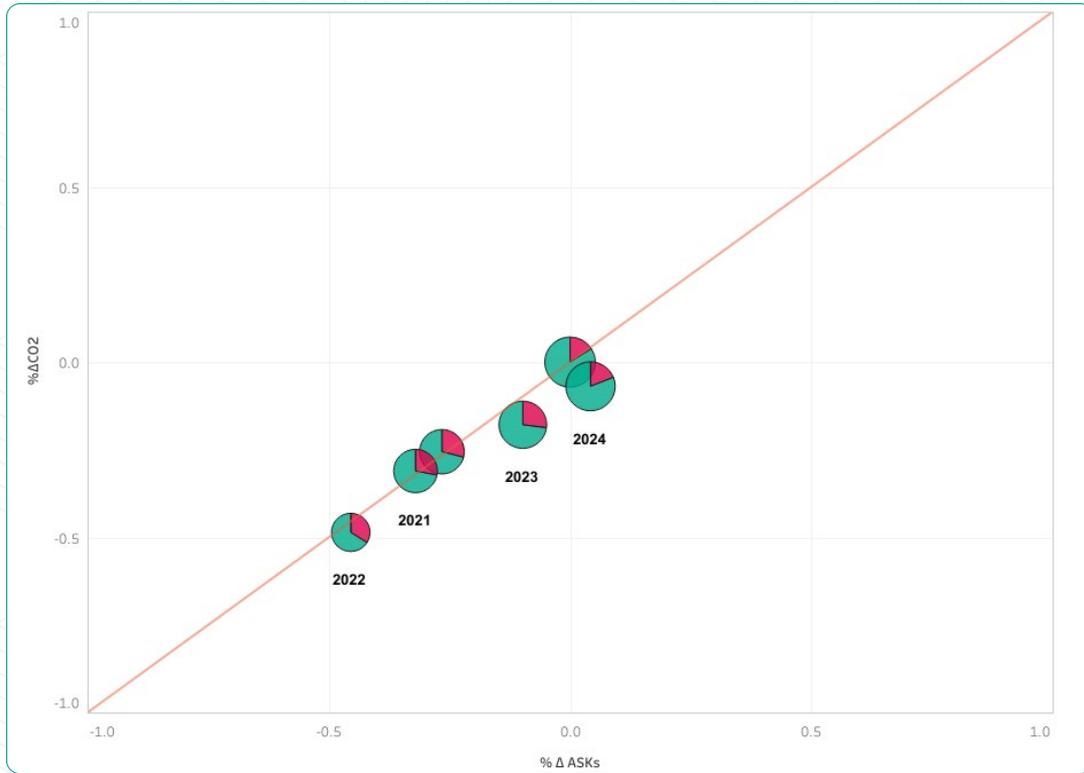
WestJet



Wizz Air



Xiamen Airlines



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