



The State of Sustainable Advertising

December 2023

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Executive Summary

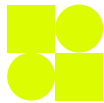
This end-of-year report offers an updated view into where emissions in the digital advertising supply chain exist and how the industry's carbon footprint continues to evolve. It includes emissions data for an expanded list of countries to provide a comprehensive picture of how carbon output differs across the globe.

The report also provides an analysis of the industry's current decarbonization

trajectory and insights into the potential impact if swift and aggressive action is taken to eliminate climate risk inventory. The results highlight a massive opportunity in the year ahead.

Finally, a special feature on bot traffic explores how emissions data can be used to expose the climate impact of waste in the ad ecosystem.

Key Takeaways



For half the countries analyzed, gCO₂PM decreased on average 9.3% over six months.



Removing climate risk inventory would decrease gCO₂PM by more than 25% in every country.



Aggressively decreasing emissions from the ad selection process would have a meaningful impact on carbon reduction efforts.



In the US, 58.8 grams of CO₂ emissions are wasted on fraud for every 1,000 impressions.

The Emissions Data

Global emissions output

Open access to emissions data is the first step toward a more sustainable advertising industry. Since our first report in April 2023, Scope3 has consistently shared data that brings attention to digital advertising’s impact on the planet.

Figure 1 displays the average grams of carbon emissions per 1000 impressions (gCO₂PM) by country across three digital channels: display, app, and streaming.

Wide ranges of gCO₂PM are common, with some countries averaging in the low- to mid-200s and others as high as 700+.

Differences can be attributed to energy grid variations, the supply chain complexity of ad stacks for high-volume publishers, as well as buying practices among brands and agencies in each country.

Emissions output around the world

figure 1

Average gCO₂PM across channels

Country	Display Web	Display App	Streaming Video
Argentina	339 . 4	468 . 4	881 . 0
Australia	293 . 3	324 . 9	755 . 0
Canada	269 . 9	331 . 3	778 . 7
Chile	401 . 4	465 . 0	1 , 134 . 0
France	426 . 9	428 . 6	660 . 0
Germany	586 . 9	461 . 9	991 . 0
UK	371 . 3	384 . 1	770 . 0
India	363 . 4	368 . 6	1 , 187 . 0
Indonesia	491 . 7	238 . 0	1 , 076 . 0
Italy	485 . 6	587 . 8	668 . 0
Mexico	393 . 3	475 . 8	818 . 0
Philippines	270 . 9	406 . 8	782 . 0
Singapore	342 . 6	266 . 4	711 . 0
Spain	614 . 0	423 . 3	740 . 0
US	267 . 8	403 . 2	815 . 0

Average gCO₂PM across display, app, and streaming by country, Scope3 December 2023 Report

How climate risk inventory skews the data

Another way to look at the data is through a ‘carbon filter.’ If the industry were to eliminate extremely high emissions inventory, referred to as climate risk inventory, every market’s average gCO₂PM would drop by more than 25%.



Emissions drop **37%** on average when climate risk inventory is eliminated.

In some countries, like Germany, the US, and the UK, the impact would be even greater, with average gCO₂PM nosediving 61%, 47% and 46%, respectively.

A visual representation of how this impacts the distribution of advertising emissions is displayed in figure 2b. The yellow illustrates what the spread of impressions by gCO₂PM emissions grouping in France could look like if high-carbon impressions were avoided. Climate risk impressions are represented in orange.

When climate risk inventory is included, averages increase and far more impressions are distributed to the right, indicating the presence of high-emissions inventory.

Eliminating climate risk inventory

gCO₂PM of display web advertising with and without climate risk

figure 2a

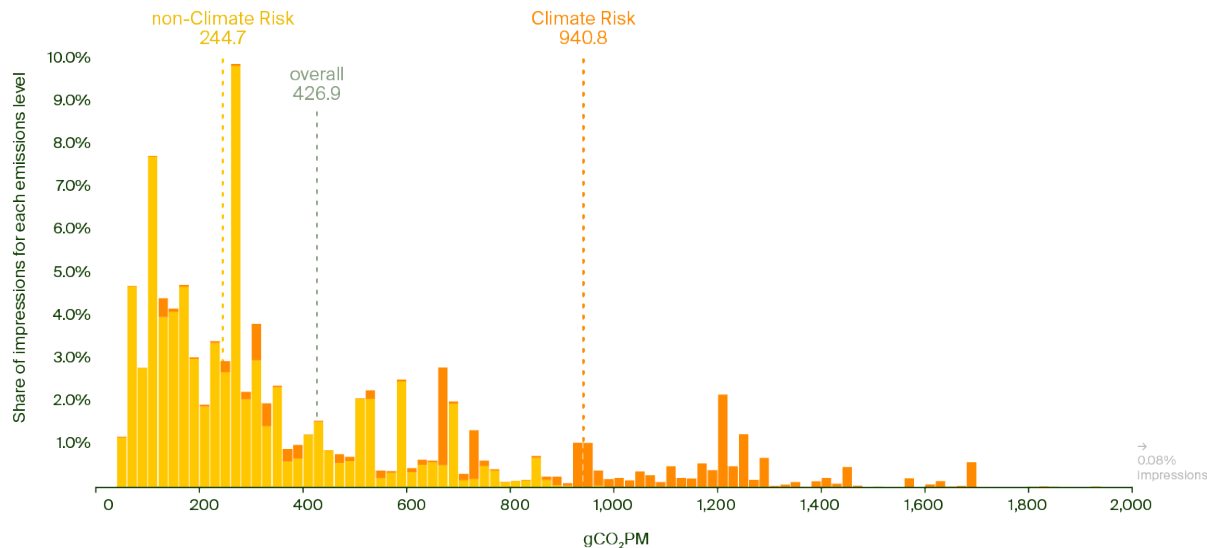
	Average gCO ₂ PM	Average gCO ₂ PM without Climate Risk	Percentage Decrease
Argentina	339 . 4	244 . 6	-27.9
Australia	293 . 3	188 . 8	-35.6
Canada	269 . 9	192 . 9	-28.5
Chile	401 . 4	288 . 7	-28.0
France	426 . 9	244 . 7	-42.6
Germany	586 . 9	230 . 1	-60.7
UK	371 . 3	200 . 0	-46.1
India	363 . 4	254 . 4	-29.9
Indonesia	491 . 7	265 . 2	-46.0
Italy	485 . 6	329 . 1	-32.2
Mexico	393 . 3	239 . 0	-39.2
Philippines	270 . 9	199 . 9	-26.2
Singapore	342 . 6	228 . 6	-33.2
Spain	614 . 0	425 . 4	-30.7
US	267 . 8	141 . 0	-47.3

Average gCO₂PM compared to average gCO₂PM without climate risk for display web by country, Scope3 December 2023 Report

Removing climate risk in France

The distribution of impressions in France with and without climate risk inventory, display web

figure 2b



Impression distribution in France by gCO₂PM bucket, Scope3 December 2023 Report

Emissions over time

Scope3 began collecting emissions data in early 2022 and has monitored changes over time. Using baseline emissions established in the first installment of this report, it is now possible to analyze trends at a macro level.

About half of the countries studied have recorded a decrease in average gCO₂PM since June, while the other half increased or remained steady. There is no evidence of systemic behavior change, however this data exposes positive examples of downward emissions trends at the market level.

For markets where emissions decreased, gCO₂PM dropped on average 9.3% over six months. Large decreases were recorded in France, Canada, and Germany, which were all down about 12%. Conversely, gCO₂PM increased in markets like the UK (up 8.9%) and Spain (up 16.1%).

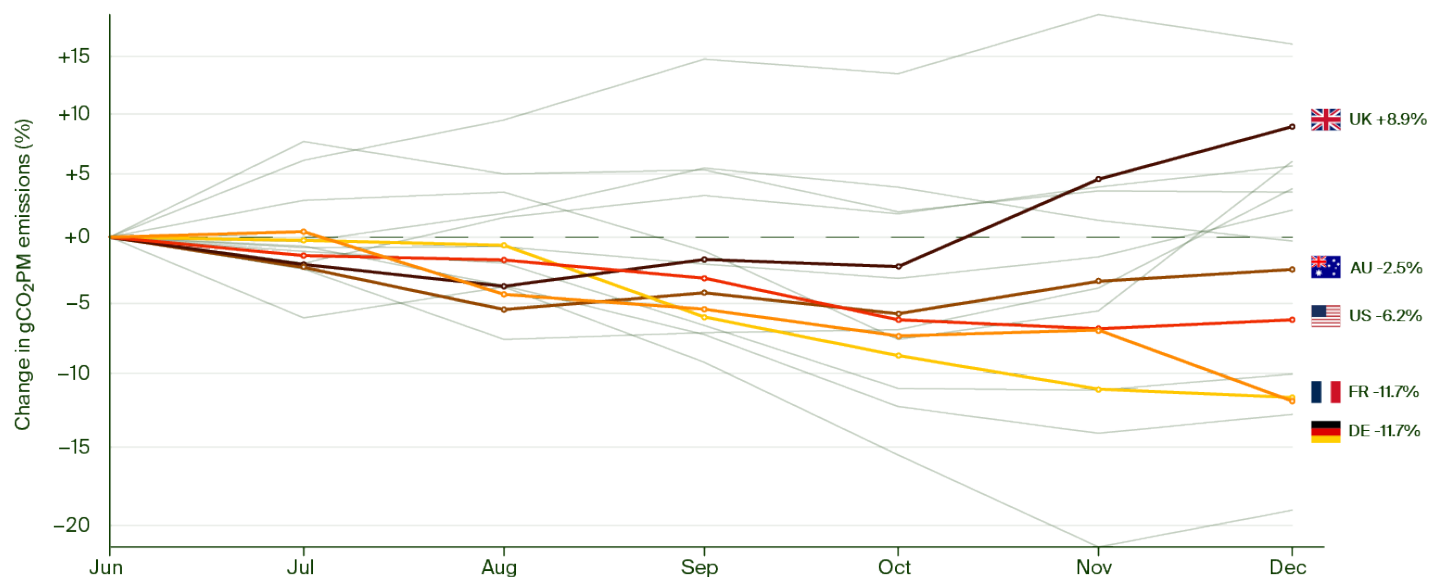
It’s also worth noting that recently there’s been a small uptick in emissions across the board – nearly every country recorded an increase in gCO₂PM between October and December.

Fluctuations in emissions can be attributed to a number of factors. How media is bought and sold has a tremendous impact. Seasonality also plays a role, given budgets are often higher in Q4 and the fact that added spend is not distributed equally. As more data accumulates, pinpointing the driving forces behind these changes will get easier.

Deeper analysis into two instances where emissions output changed dramatically, and explanations around what might be the cause, follows.

Six month view of ad industry emissions
Change in average emissions from June to December

figure 3



Emissions changes over time by country, Scope3 December 2023 Report

Isolating trends in the data: When emissions rise

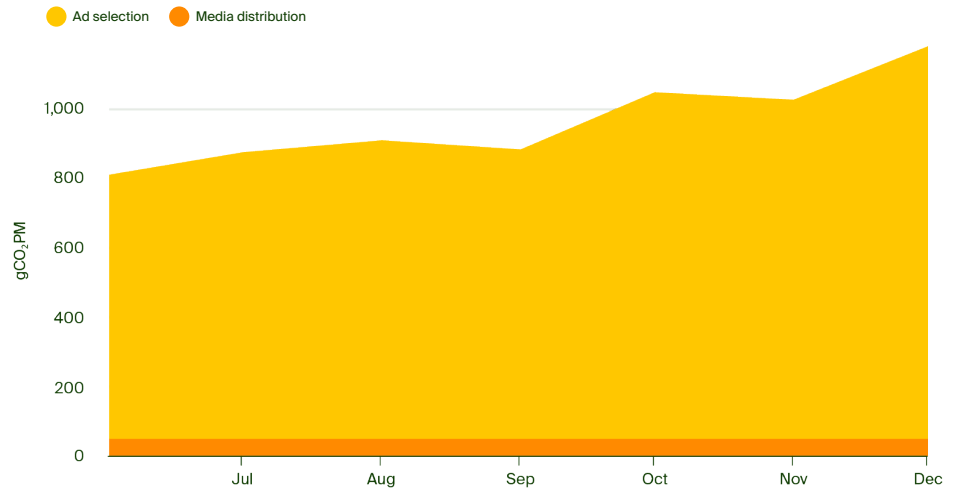
Emissions output in the UK increased 8.9% since June.

Increases were noticeable in two areas of the advertising life cycle: ad selection (+16 gCO₂PM) and creative delivery (+2 gCO₂PM). The former was likely due to gCO₂PM increases across high-traffic properties, and the latter to an increase in the usage of slightly heavier ad formats (e.g. video vs. display banner).

Noticeable trends at the media-property level contributed to this increase. Several properties (such as figure 4a) recorded significant jumps in gCO₂PM, and many of those properties also garnered a steep increase in impressions, relatively speaking.

Example of emissions increasing

figure 4a



One example of a UK publisher significantly increasing emissions over time, Scope3 December 2023 Report

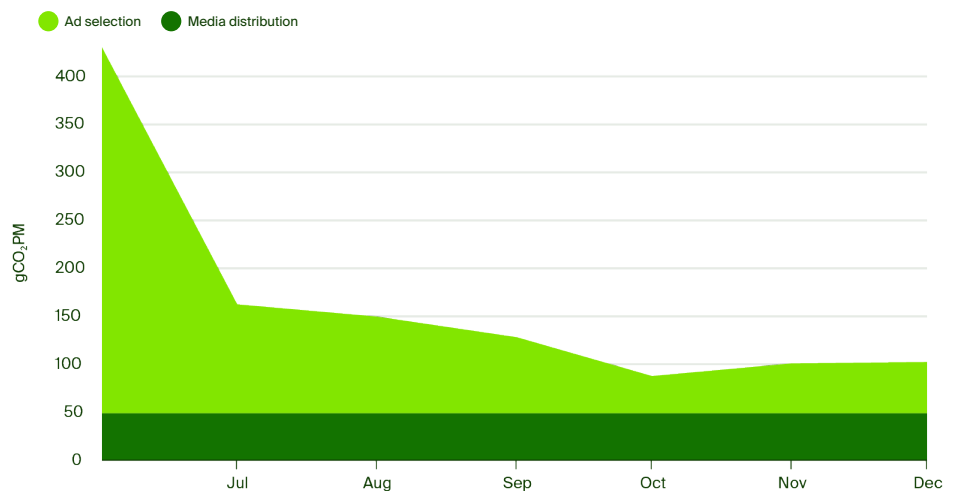
Isolating trends in the data: When emissions go down

US emissions output is on a downward trend. The data shows media distribution and creative delivery remained flat, while ad selection dropped 19 gCO₂PM. This decrease is the opposite of what we observed in the UK. High-volume properties in the US became a lot 'greener' over the period analyzed (figure 4b shows one example).

When publishers with high impression volumes reduce emissions, the impact can be noticed at the market level. There were a few high-impression publishers whose average gCO₂PM improved significantly since June that contributed to pulling down the market-level gCO₂PM averages in countries like the US and Canada.

Example of emissions declining

figure 4b



One example of a US publisher significantly decreasing emissions over time, Scope3 December 2023 Report

The path to decarbonization

In 2023, the digital advertising industry recognized the urgency of the climate crisis, and began shifting their mindset from 'wait and see' to 'what actions can I take now.'

The window to keep global temperatures from exceeding the 1.5°C threshold is narrowing. Carbon savings will mainly come from future emissions that are avoided, rather than relying on carbon removal. Any efforts made now will have a cumulative impact on future emissions levels.

The more timely and aggressive action taken now, the greater the amount of long-term carbon savings. For digital advertising, even a little bit of effort can have an enormous impact.

The Opportunity in 2024

Meaningful carbon reduction is achievable today. The data and tools exist to take action against one of the biggest sources of emissions in digital advertising: ad selection.*

Ad selection is a massive opportunity for a few reasons. First, it accounts for a significant portion of emissions in advertising, and drawing that number down will meaningfully reduce the industry's carbon footprint. Second, removing supply chain complexity can be implemented quickly. In a matter of days, media buyers and owners can experience the benefits of reduced emissions with significant impact.

If the industry cut out the majority of emissions from the media supply chain, aiming for near-zero emissions from ad selection (reducing to <1 gCO₂PM), the carbon savings would be enormous. Looking at US figures, a steady monthly decrease of 10% in gCO₂PM would equate to more than five million metric tons (mt) of cumulative carbon emissions savings, or 87.6%, by 2030.



Cutting ad selection can drive over 5M mt of carbon emissions savings by 2030.

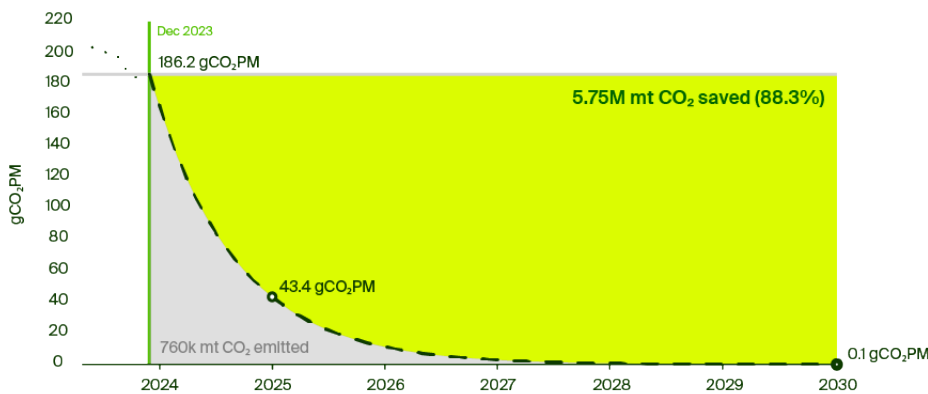
That may seem aggressive, but consider those savings against the current trend in the US – the US is tracking at an average monthly gCO₂PM decrease of 1.4%. Continuing on that path would result in cumulative savings on emissions of 2.46 million mt (37.7%); however, still emitting 4.06 million mt.

On the following page, there are four different scenarios outlining the possible decarbonization trajectory of digital advertising depending on how the industry decides to take action in the coming years.

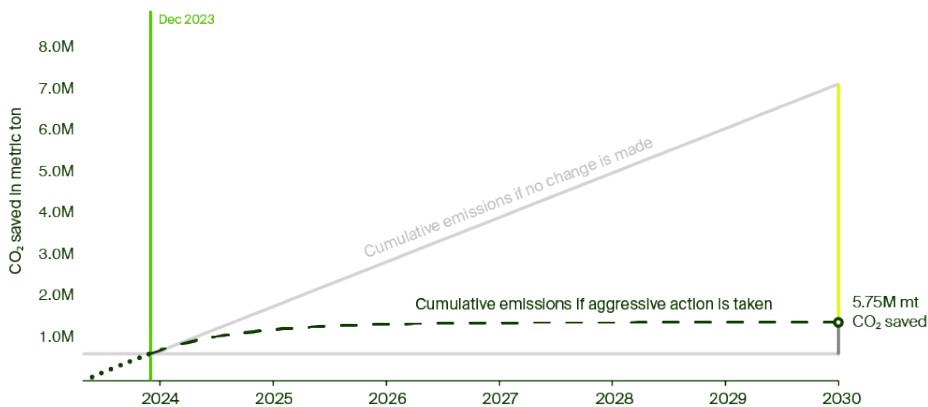
Taking aggressive action today

Cumulative carbon savings from cutting ad selection in the US

figure 5



Ad selection gCO₂PM (i.e., rate of emissions per impression) descent in an ideal world



Projected cumulative carbon emissions with associated metric tons of CO₂ emissions saved

*Ad selection: Total emissions associated with the supply path from the inventory ad slot and the complete graph of all advertising parties involved, including the scope 1, 2, and 3 emissions of each party per impression.

Understanding the potential impact of taking action

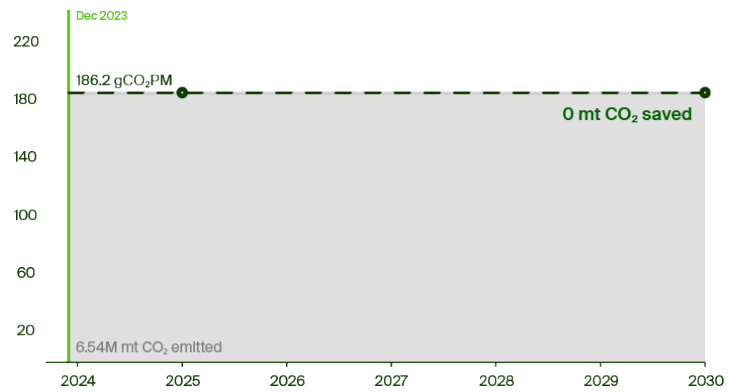
The power of taking action is visualized in this series of graphs. Based on how quickly the industry can cut emissions from ad selection, the potential to reduce our carbon footprint is clear.

In order, these graphs show changes in gCO₂PM tied to ad selection emissions in the US, and the cumulative carbon savings of reducing that number based on sustained month-over-month decreases of 0%, 1.4%, 5.3% and 10.6%.

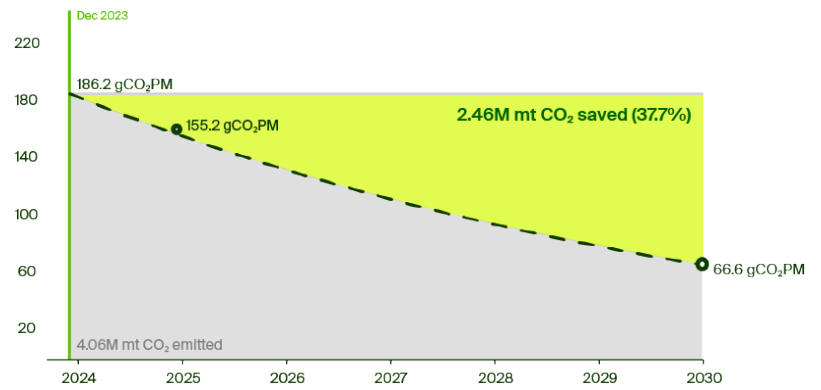
Impact of reducing US display ad emissions from ad selection, figure 6.

Path 1: Continue emitting at current rate

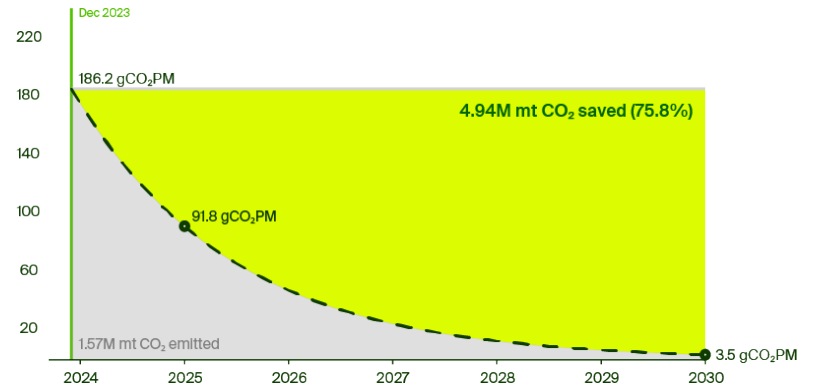
figure 6



Path 2: Sustain current descent

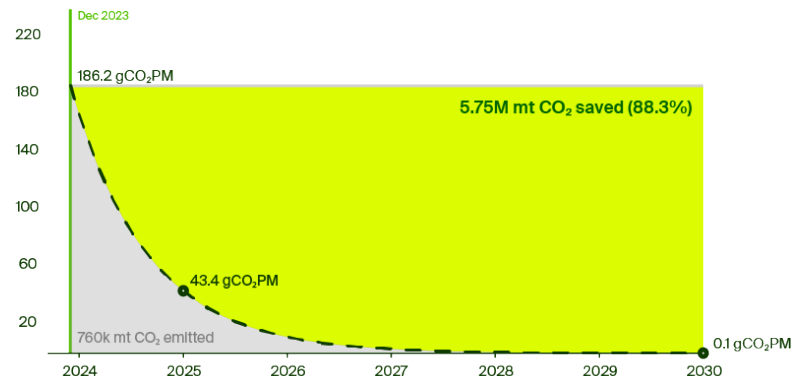


Path3: Eliminate 'climate risk' industry-wide



Path 4: Reach near-zero ad selection emissions

IDEAL



Building a Sustainable Ad Ecosystem

In previous reports, emissions data was combined with performance, privacy, and attention data. Those studies brought increased visibility to some of the industry’s long-standing obstacles, such as supply chain transparency and MFA. They exposed previously hidden pockets of waste and uncovered

correlations between sustainable media and better advertising.

Based on recent news around the pervasiveness of fraud and bot traffic online, Scope3 conducted another study to understand the climate impact of this industry problem.

The climate impact of fraud

The Telegraph recently published an investigation into the anatomy of click farms, documenting some of their inner workings – one alarming finding: “as much as half of all internet traffic is fake.”

Also noted in the piece was fake traffic's impact on both consumers’ perception of popular opinion and the cost to marketers – nearly \$100 billion is wasted annually on displaying ads to an audience that doesn’t exist.

Beyond societal and financial damages, we sought to explore the environmental

impact this might have given what we already know about waste online. To determine the extent of the climate threat associated with diverse forms of fraud, we partnered with FouAnalytics, a firm that specializes in measuring fraud in ad interactions and overall website activity.

Notably, FouAnalytics is able to identify certain fraudulent practices that remain concealed during routine website inspections, only manifesting when specific codes are embedded in the URL. These mechanisms can result in a surge of additional web requests, inevitably causing increased levels of emissions.

For this study, we utilized a representative sample of 3,024 sites in the US spanning various categories, measuring the presence of fraudulent activity in relation to monthly impression volume and emissions.

Figure 7 plots fraudulent activity versus emissions by site, where the size of each dot represents the volume of impressions. The bottom-left region indicates low-fraud, low-emissions inventory – approximately 61% of the inventory (fraud <30%, emissions <200 gCO₂PM). The remaining 39% is waste in the ecosystem. Advertising on sites known for fraud is not worthwhile, especially given the outsized emissions.

Applying a carbon lens to fraud

Fraudulent activity versus emissions by site, with a density plot overlay

figure 7



Scope3 measures the relationship between emissions and fraud by: grams of gCO₂ per 1,000 non-fraudulent impressions, also referred to as effective gCO₂PM (e-gCO₂PM). For example, if a website emits 100 gCO₂PM and has a fake interaction rate of 25%, the resulting effective emissions would be 150 e-gCO₂PM.

Using that metric, the distribution of emissions pulls higher when fraud is filtered out, with a ~33% higher median e-gCO₂PM: from 127 to 168.7. Additionally, the impression-weighted average increases to 245 e-gCO₂PM, indicating that 21.7% of emissions are associated with fake web activity.



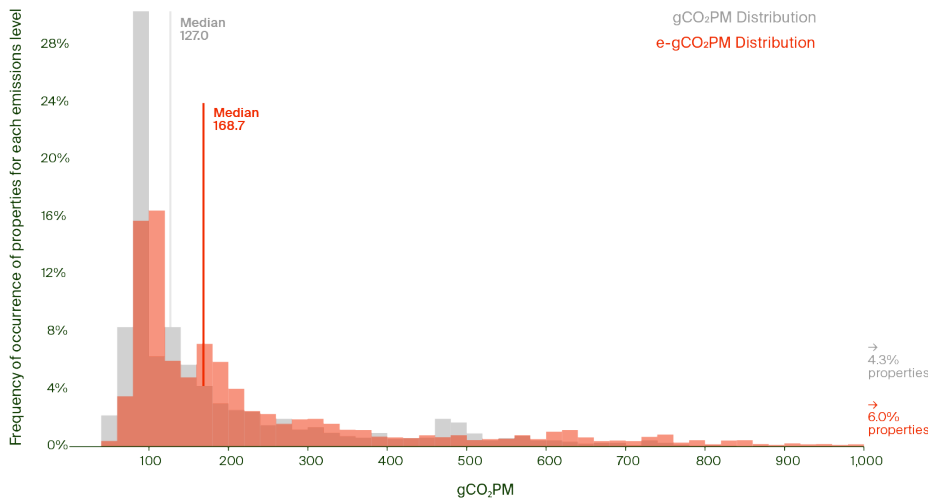
Fraud in US programmatic display contributes an estimated 353k mt of carbon emissions

Applying this figure to the total emissions associated with US programmatic display (267.8 gCO₂PM, from page 3), the result is that 58.8 grams of CO₂ emissions are wasted on fraud every 1,000 impressions. With an estimated 500 billion monthly impressions, the estimate is that 352.8k mt of emitted CO₂ is wasted on fraud every year in the US alone.

Filtering out fraud

How fraud impacts the distribution of emissions

figure 8



Emissions distribution with and without fraud, Scope3 December 2023 Report

Methodology

For the report, we used representative samples from Scope3 API activity occurring from Q2 to Q4. The samples are representative of players across the display and streaming advertising spaces: billions of impressions across tens of thousands of domains/apps on desktop, mobile, and TV, including the long tail. The figures include video and banner formats.

With this data we assess overall ad tech emissions trends across three emission categories (ad selection, media distribution, and creative distribution). The normalized unit for the report is grams of CO₂e per thousand impressions (gCO₂PM), and the values derived are weighted averages of emissions associated with activity

measured across the domains and apps in that specific market.

We use a third-party data source, BIScience, to provide impression activity data for the top websites and apps across a variety of geos, and use that in combination with our emissions data to assess total emissions values for a given market. We also leverage the BIScience data set for validating representativeness of Scope3 API samples.

More information on Scope3's emissions model is publicly available on GitHub, [here](#).

About Scope3

Scope3 is on a mission to decarbonize media and advertising.

Scope3 makes it easy for everyone in the advertising ecosystem to visualize, measure, and reduce their carbon emissions. This is made possible with Scope3's first-of-its-kind emissions model developed from open-source methodology to precisely measure the complex and interconnected advertising ecosystem. The model sits at the core of Scope3's collaborative sustainability platform and every emissions reduction

solution offered by the company, including Climate Shield and Green Media Products (GMPs).

Scope3 is a Public Benefit Corporation with a global team of researchers, technologists, and digital advertising pioneers distributed across North America, Europe, and APAC, tackling the biggest challenge of our generation: the climate crisis.

Learn more at scope3.com.

