



Waymo One Avoided Emissions Methodology

1.0 Introduction

Waymo seeks to build trust and awareness of the environmental benefits from shared, electric, autonomous mobility. As a transportation services company, an impact of significant interest is greenhouse gas emissions. The goal of the methodology is to share how Waymo estimates avoided greenhouse gas emissions from each trip serviced by Waymo's zero-emission ride-hailing service — Waymo One. Waymo's overall corporate greenhouse gas emissions are reported and consolidated under Alphabet's annual CDP Climate Change Response Report.¹

The methodology compares estimated emissions from Waymo One service to the annual emissions targets set for ride-hail companies by California's Clean Miles Standard. Avoided emissions estimates can inform riders, partners, and stakeholders about the environmental benefits of individual rides and the collective impact of our ride-hailing services.

2.0 Scope

Waymo One currently provides fully autonomous ride-hail services in Phoenix, San Francisco, and Los Angeles, with plans to expand to Austin. Although Phoenix and Austin are outside of California, we still estimate avoided emissions for Waymo's operations in those regions using California's Clean Miles Standard for purposes of calculating the baseline due to the absence of other applicable ride-hail emissions standards. Note that this approach may underestimate emissions reductions outside California, as the average ride-hailing trip in other states may have higher emissions than those modeled in the Clean Miles Standard.²

This methodology estimates the greenhouse gas (GHG) emissions from a single Waymo One trip and compares them to the annual GHG targets (GHG emissions/passenger mile) set for ride-hail companies by California's Clean Miles Standard. Consistent with the Clean Miles Standard, the methodology does not factor in upstream emissions related to fuel production and distribution because only tailpipe CO₂ emissions were specified in the enabling legislation.³

¹ Alphabet, "Alphabet's 2023 CDP Climate Change Response."

² Electric vehicles (EVs) comprise a smaller share of vehicles in Arizona and Texas than in California. California's regulatory environment, which includes state incentives for EVs and supported earlier buildout of EV charging infrastructure, has accelerated EV adoption in California ride-hailing fleets. Accordingly, using the California Clean Miles Standard (CMS) targets, which by design reflects a higher share of EVs than the status quo, may underestimate the actual emissions avoided from Waymo One in jurisdictions with lower EV adoption rates than in California. This gap could widen as California's policies, including the CMS, further drive EV adoption; Energy Information Administration, "Electric Light-Duty Vehicles Overview."

³ California Air Resources Board, "Addendum to the Final Statement of Reasons for Rulemaking Public Hearing to Consider the Clean Miles Standard Regulation."

3.0 California Clean Miles Standard

The California Air Resources Board adopted the Clean Miles Standard in May 2021 — a first-of-its-kind fleet regulation to reduce vehicle emissions from ride-hailing services.⁴ The Clean Miles Standard is a regulation developed by the California Air Resources Board and implemented by the California Public Utilities Commission. The Clean Miles Standard regulation set annual emissions targets that are reduced each year, culminating with a goal of 90% electric vehicle miles traveled by 2030 and 0 grams of carbon dioxide per passenger mile traveled (g CO₂/PMT) by 2030.

4.0 Methodology

Our custom methodology for estimating emissions aligns with regulatory standards and guidance from the GHG Protocol on product comparisons, and policy and action standards. These standards and the methodology are described further below.

- **Baseline Scenario:** We utilize California's Clean Miles Standard annual emissions targets for ride hailing platforms as the baseline for estimating ride-hail emissions that would otherwise occur.
- **Waymo One Emissions:** Our Jaguar I-PACE electric vehicles are zero-emission certified. We procure electricity from renewable electricity sources (utility partnerships, community choice programs, and renewable energy certificates). Our fuel carbon intensity is 0 grams of CO₂ per kWh, as determined under California's Low Carbon Fuel Standard.
- **Comparison:** Waymo One's emissions are directly compared to the Clean Miles Standard targets, demonstrating the environmental benefits of our service.

4.1 Baseline Scenario

We assume that without Waymo, each Waymo One trip would be completed through a different ride-hailing platform. We estimate that these trips on average would result in GHG emissions at, but not exceeding, the annual California's Clean Miles Standard target. This allows us to estimate emissions savings.

The baseline scenario is “a reference case that represents the events or conditions most likely to occur in the absence of the assessed product,” and “represents what would have happened in the absence of the policy or action being assessed.”⁵

The methodology follows the guidelines from the Greenhouse Gas Protocol (GHG Protocol) to identify a baseline comparison. The GHG Protocol establishes standardized frameworks to measure and manage emissions from private and public sector operations, value chains, and mitigation actions.⁶

⁴ California Air Resources Board, “Clean Miles Standard - About.”

⁵ World Resources Institute, “Estimating and Reporting the Comparative Emissions Impacts of Product.”; Greenhouse Gas Protocol, “Policy and Action Standard.”

⁶ GHG Protocol, “About Us.”

While the GHG Protocol lacks specific standards for comparing emissions from different transportation modes, it does provide guidance on how to 1) quantify comparative product emissions, and 2) estimate emissions impacts from policies and actions. The methodology builds on Estimating and Reporting the Comparative Emissions Impacts of Products, a neutral framework for estimating and disclosing the GHG emissions impact of a good or service.⁷ The methodology also incorporates the Policy and Action Standard, which provides a standardized approach for estimating and reporting the changes in emissions resulting from policies and actions, including introduction of new products.⁸

4.2 Waymo One Emissions

Under the Clean Miles Standard emissions methodology, the CO₂ emissions factor for Waymo One remains consistently 0 grams of CO₂ per mile as our fleet consists entirely of electric vehicles (EVs). The Waymo One fleet of Jaguar I-PACE electric vehicles is certified by the California Air Resources Board as a zero-emission vehicle.⁹

While the Clean Miles Standard doesn't require it, Waymo sources renewable energy to power our passenger carrier vehicles, eliminating upstream emissions associated with electricity generation. We source renewable energy to power our EV fleet through a combination of 1) enrolling in renewable energy programs offered by utilities and community choice energy providers, 2) partnering with our charging network providers to purchase renewable energy, and 3) purchasing Renewable Energy Certificates to fill any gaps.

- In California, Waymo purchases renewable electricity directly from local utilities and community choice energy programs, including the CleanPowerSF SuperGreen program.¹⁰ EV chargers powering Waymo's fleet are also enrolled in California's Low Carbon Fuel Standard (LCFS) program. The renewable electricity meets applicable LCFS standards under the Book-and-Claim pathway and is reported to the California Air Resources Board's LCFS program quarterly. The LCFS program considers the carbon intensity of renewable electricity to be zero (0 grams of CO₂ per kWh).¹¹
- Outside of California, Waymo purchases renewable electricity directly from local utilities when possible, including the Arizona Public Service's GreenChoice program and Salt River Project's Project Redhawk.¹² When Waymo cannot purchase renewable energy from local utilities, Waymo will purchase renewable energy certificates that are certified by the Green-e® program.¹³

⁷ World Resources Institute, "Estimating and Reporting the Comparative Emissions Impacts of Products."

⁸ Greenhouse Gas Protocol, "Policy and Action Standard."

⁹ California Air Resources Board, "Exec. Order. No. A-409-0075."

¹⁰ CleanPowerSF, "2023 SuperGreen Prospective Product Content Label."

¹¹ California Air Resources Board, "Low Carbon Fuel Standard (LCFS) Guidance 19-01 Book-and-Claim Accounting for Low-CI Electricity."

¹² APS, "Business Green Choice Program.;" SRP, "Project Redhawk."

¹³ Center for Resource Solutions, "Green-e® Renewable Energy Standard for Canada and the United States."

4.3 Comparison

Avoided emissions are estimated by comparing Waymo One emissions (which are zero due to Waymo One's fully electric, zero-emission fleet) to the baseline. The baseline is the equivalent trip emissions of a ride-hail vehicle with an emissions factor complying with, but not exceeding, the Clean Miles Standard (CMS) annual GHG targets.¹⁴

$$\text{Avoided Emissions (gCO}_2\text{)} = \text{Waymo One Trip Emissions (gCO}_2\text{)} - \text{Baseline Trip Emissions (gCO}_2\text{)}$$

Equation (1) Waymo One Avoided Emissions

Baseline Trip Emissions

To calculate baseline emissions we use the following CMS equation for ride-hail companies to calculate GHG emissions per passenger mile.

$$\frac{gCO_2}{PMT} = \frac{\sum(VMT_{P1,P2,P3} \times CO_2 \text{ factor})_{trip}}{\sum(VMT_{P3} \times occupancy)_{trip}}$$

Equation (2) Clean Miles Standard GHG emissions per passenger mile

Where:

- $VMT_{P1,P2,P3}$ equals vehicle miles traveled in miles (sum of Periods 1, 2 and 3) of trips for all vehicles
- VMT_{P3} equals vehicle miles traveled in miles for the Period 3 portion of a trip
- CO_2 factor equals the CO_2 emissions factor in grams CO_2 per mile
- Occupancy equals the compliance occupancy value assumed by the California Air Resources Board, 1.5 passengers for non-pooled or pool-requested-unmatched trips and 2.5 passengers for pool-matched trips¹⁵

Definitions:

- "Period 1" are those miles traveled by a ride-hail vehicle when a ride-hail vehicle driver or operator is logged onto the app and waiting for a ride match.
- "Period 2" are those miles traveled by a ride-hail vehicle when a ride-hail vehicle driver or operator has accepted a ride request and is en route to the passenger.

¹⁴ California Air Resources Board, "Final Regulation Order Clean Miles Standard."

¹⁵ Waymo's baseline trip estimates follow the CMS assumed occupancy value of 1.5 passengers for non-pooled rides in the methodology. As explained above, Waymo One trips are fully electric and therefore result in zero emissions. Therefore vehicle occupancy is irrelevant to the calculation of Waymo One trip emissions. Waymo does not currently offer pooled rides, therefore the pooled occupancy value is not included in the methodology.

- “Period 3” are those miles traveled by a ride-hail vehicle when the passenger, or passengers, are in the ride-hail vehicle and en route to their destination until the passenger exits the vehicle.
- “Passenger Miles Traveled” or “PMT” means the miles traveled by a passenger, or miles traveled by each passenger if there are multiple passengers for a trip.
- “Vehicle miles traveled” or “VMT” means the distance traveled by a ride-hail vehicle, and includes all miles traveled (sum of Periods 1, 2, and 3).

Estimating the Baseline Trip Emissions

The Baseline Trip Emissions refers to the trips emissions for a baseline case. Mathematically, it is the numerator of Equation (2).

$$\text{Baseline Trip Emissions} = \sum (\text{VMT}_{P1,P2,P3} \times \text{CO}_2 \text{ factor})_{\text{trip}}$$

(gCO₂)
(VMT)
(gCO₂/VMT)

Equation (3) Baseline Trip Emissions

The Clean Miles Standard requires ride-hail companies to stay below emissions targets per passenger mile traveled (PMT) through 2030, seen in the table below. As described in our Baseline Scenario Section 4.1, we utilize California's Clean Miles Standard annual emissions targets for ride hailing platforms as the Baseline comparison.

Clean Miles Standard Annual GHG Target							$\frac{gCO_2}{PMT}$
2024	2025	2026	2027	2028	2029	2030	
237	207	161	110	69	30	0	

The Baseline Trip Emissions can be estimated using Equation (4) below, which is derived from Equations (2) and (3). Equation (4) leverages the known annual GHG emissions target, VMT_{P3} , and an assumed occupancy of 1.5 passengers:

$$\text{Baseline Trip Emissions} = \text{Annual GHG Target} \times (\text{VMT}_{P3} \times \text{occupancy})_{\text{trip}}$$

(gCO₂)
(gCO₂/PMT)
(PMT)
(passengers)

Equation (4) Baseline Trip Emissions

Waymo One Avoided Emissions Calculation

The avoided emissions are then calculated by subtracting the Baseline Trip Emissions from the Waymo One emissions using Equation (4):

$$\begin{aligned} \text{Avoided Emissions} &= \text{Waymo One Emissions} - \text{Baseline Trip Emissions} \\ (\text{gCO}_2) & \quad (\text{gCO}_2) \quad (\text{gCO}_2) \\ &= 0 - \text{Baseline Trip Emissions} \\ &= - \text{Baseline Trip Emissions} \end{aligned}$$

Equation (5) Waymo One Avoided Emissions

5.0 Conclusion

Waymo is committed to transparent, rigorous, and continuously evolving methodologies for estimating avoided emissions. To maintain this standard, we will actively monitor, update, and revise our approach in key areas including:

- **Standards:** Aligning our methodology with the latest regulations and best practices within the mobility and transportation industries.
- **Performance:** Tracking our success in delivering emissions reductions, including our renewable energy efforts.
- **Comparisons:** Ensuring accurate ride-hail comparisons and integrating regional emissions data as it becomes available for greater context.

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