ENVIRONMENTAL LAW & POLICY CENTER

CLEAN TRANSPORTATION

Carbon Impact by Travel Mode

Includes impacts of manufacturing, fuel, and direct emissions produced per mile. Walking & biking numbers include the impact of food burned per mile. Does not account for road wear, land use impacts, or other pollutants.

350g/mi

GAS CAR

The Department of Energy estimates 348 grams of carbon emissions per mile in 2021, including manufacturing.[1] A recent New York Times article estimated a range of 300-850+ g/mi.[2]

200g/mi

ELECTRIC VEHICLE

An MIT 2019 study estimated just 200 grams of carbon emissions per mile for electric vehicles, depending on the size of vehicle & local electric mix.[4] A recent New York Times article estimated a range of 150-350g/mi.

127g/mi

PUBLIC TRANSIT

According to the US Congressional Budget Office, average bus & rail transit impact is 127g/mi per passenger. The National Academies estimates that it's closer to 230g per passenger mile.[6] [7]

80g/mi

WALKING

A UK study estimated that walking created 81-419 grams of carbon emissions per mile, based on calories burned per mile, with an average meat-heavy diet.[3]

33g/mi

TRADITIONAL BIKE

A European study estimated an average manufacturing impact of 96kg over a 19,200km lifespan, or 5g/mi. Plus a food impact of 16g/km for the rider. Total 21g/km = 33.8g per mile.[5]

25g/mi

ELECTRIC BIKE

A European study estimated a manufacturing impact of 7g/km, plus food impact of 6.3g/km. Average American electricity impact adds 2.18g/km.[8] Total 15.48g/km = 24.92g per mile.

---

[1] FOTW #1223, January 31, 2022: Average Carbon Dioxide Emissions for 2021 Model Year Light-Duty Vehicles at an All-Time Low. https://www.energy.gov/eere/vehicles/articles/fotw-1223-january-31-2022-average-carbon-dioxide-emissions-2021-model-year

[2] New York Times: Just how green is that electric pickup truck? Feb 18, 2023 https://www.nytimes.com/interactive/2023/02/17/climate/electric-vehicle-emissions-truck-suv.html

[3] Nature: Fueling walking and cycling: human powered locomotion is associated with non-negligible greenhouse gas emissions https://www.nature.com/articles/s41598-020-66170-y

[4] MIT Climate Portal: Are electric vehicles definitely better for the climate than gas-powered calls? https://climate.mit.edu/ask-mit/are-electric-vehicles-definitely-better-climate-gas-powered-cars

[5] BikeRadar: How green is cycling? Riding, walking, ebikes and driving ranked https://www.bikeradar.com/features/long-reads/cycling-environmental-impact/

[6] Congressional Budget Office: Emissions of Carbon Dioxide in the Transportation Sector, December 2022 https://www.cbo.gov/publication/58861

[7] National Academies: An Update on Public Transportation's Impacts on Greenhouse Gas Emissions https://nap.nationalacademies.org/download/26103

[8] CarbonFund.org: Calculation Methods - Electricity Generation https://carbonfund.org/calculation-methods/

ENVIRONMENTAL LAW & POLICY CENTER

CLEAN TRANSPORTATION

March 2023

Environmental Benefit an E-Bike Rebate

Electric bikes create no carbon emissions or air pollution while riding. But even considering the impacts of manufacturing, electric charging, and food for the rider, an e-bike is responsible for 93% less climate impact than a fossil-fueled passenger vehicle per mile. Many cities, states, and utilities are looking into e-bike rebates to reduce pollution and congestion. If Chicago implemented a Denver-style rebate program, we could get thousands of people out of their cars and reduce carbon emissions.

Denver's E-Bike Rebate Program[9]

In the first round, Denver offered $400 for city residents to purchase an e-bike at a local shop, $1,200 for low-income residents, and a bonus of $500 for cargo bikes, which can carry children and large loads. No rebates for electric mountain bikes. It **cost $4.8 million and reached 4,726 riders** out of the city's 711,463 population. Participants rode an average 26.2 miles per week, **22 miles** of which were **replacing car trips**. Low-income riders rode even more, at an average of 32mi/wk.

What Would That Look Like in Chicago?

Scaled up for a 3.78x larger city, Chicago could gain **17,868 riders** in a population of 2.69 million, for a cost of **$18.14 million**. If we consider the carbon impact of driving 22 miles (350g/mi x 22mi = 7,700g/mi saved), and the carbon impact of riding an ebike (24.92g/mi x 22mi = 548g/mi), then replacing the car miles with bike miles (7,700g/mi – 548g/mi) would save **7,152 grams** of carbon per rider per week. Collectively (7,152g/wk x 17,868 riders x 52 weeks per year = 6,645,180,672 g/yr), we could save **6,645.18 metric tons** of carbon dioxide emissions per year.

An e-bike rebate program would help more people and reduce more carbon for the same money.

Putting That in Context

Illinois offers $4,000 for electric vehicles. If the $18.14 million from our theoretical e-bike program went to EVs, it'd get **4,535 people driving** (instead of 17,868 people riding). Chicagoans traveled 10,148,860,000 vehicle miles in 2021, and there are 1.1 million vehicles, which averages to **9,226.24 mi/yr** per driver. For every gas car driver that switches to an EV, their emissions impact would go from (350g/mi x 9226.24mi/yr = 3,229,184 g/yr) to (200g/mi x 9226.24mi/yr = 1,845,248 g/yr), saving us **1,383,936 grams** of carbon dioxide emissions per year. For $18.19m, by switching 4,535 people to EVs, we would save (1,383,936g/yr x 4,535 = 6,276,149,760 g/yr) about **6,276.15 metric tons** of carbon dioxide emissions per year (instead of 6,645.18MT saved from switching to ebikes). So, a Chicago e-bike program would help more people and reduce more carbon for the same money.

[9] Washington Post: How Denver used e-bike vouchers to get thousands out of their cars https://www.washingtonpost.com/transportation/2022/12/19/denver-ebike-program/

Additional Considerations

The math above neglects several factors, for which I couldn't find sufficient research to be consistent across categories. I erred on the side of caution, but here are several situations that could mean that an e-bike program offers **even more bang for public buck**:

- If people swap to e-bikes from higher-emissions vehicles like vans & trucks.
- If we prioritize low-income riders since they tend to ride farther & more often.
- If Chicagoans ride farther than Denverites because our city is bigger.
- If we factor in Illinois-specific greenhouse gas emissions for charging EVs & e-bikes, because our nuclear-heavy electricity mix is less carbon-intensive than the national average.
- If we consider the co-benefits of reducing other driving-related air pollutants, such as particulate matter, nitrogen oxide, and volatile organic compounds.
- If the people switching to e-bikes eat less meat than the average American, because vegetarian/vegan diets have a lower carbon impact.
- If we factor in families & passengers, since it drops the per-person emissions impact even further. E-bikes (and especially cargo bikes) can carry heavier weights longer distances, so they can offset many family car trips that traditional bikes (or walking/transit) might not.
- If we knew more about how biking habits differed from driving. We know that riders replaced car trips with 22 miles of weekly biking, but we don't know if those trips by car would have been more mileage. Maybe they biked to a local shop instead of driving to a mall in the suburbs for the same errand, in which case the emissions savings are higher.
- If we factored in the average exercise impacts for drivers. The main emissions from walking and biking come from calories burned for food, but many drivers burn calories for exercise in addition to the emissions from their transportation. Folks using active transportation get a two-for-one: mobility and health benefits for the same carbon impact.
- If we factored in land-use impacts. Cars induce sprawl: more concrete/asphalt, more parking lots, more highways, more driving, and the more difficult walking and biking become as everything gets further away. But if we can reduce congestion by improving access to bikes and improving bike infrastructure, we can reverse these trends. Bike lanes and bike storage are much more efficient with public space, complimenting public transit & pedestrian access, which can reduce associated carbon impacts.

ENVIRONMENTAL LAW & POLICY CENTER

CLEAN TRANSPORTATION

References

FOTW #1223, January 31, 2022: Average Carbon Dioxide Emissions for 2021 Model Year Light-Duty Vehicles at an All-Time Low. https://www.energy.gov/eere/vehicles/articles/fotw-1223-january-31-2022-average-carbon-dioxide-emissions-2021-model-year

US. Dept of Transportation Federal Transit Administration: Public Transportation's Role in Responding to Climate Change, Updated January 2010 https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/PublicTransportationsRoleInRespondingToClimateChange2010.pdf

MIT Climate Portal: Are electric vehicles definitely better for the climate than gas-powered calls? https://climate.mit.edu/ask-mit/are-electric-vehicles-definitely-better-climate-gas-powered-cars

Congressional Budget Office: Emissions of Carbon Dioxide in the Transportation Sector, December 2022 https://www.cbo.gov/publication/58861

New York Times: Just how green is that electric pickup truck? Feb 18, 2023 https://www.nytimes.com/interactive/2023/02/17/climate/electric-vehicle-emissions-truck-suv.html

National Academies: An Update on Public Transportation's Impacts on Greenhouse Gas Emissions https://nap.nationalacademies.org/download/26103

Nature: Fueling walking and cycling: human powered locomotion is associated with non-negligible greenhouse gas emissions https://www.nature.com/articles/s41598-020-66170-y

BikeRadar: How green is cycling? Riding, walking, ebikes and driving ranked https://www.bikeradar.com/features/long-reads/cycling-environmental-impact/

CarbonFund.org: Calculation Methods - Electricity Generation https://carbonfund.org/calculation-methods/

Washington Post: How Denver used e-bike vouchers to get thousands out of their cars https://www.washingtonpost.com/transportation/2022/12/19/denver-ebike-program/

Greater Greater Washington: Analysis: E-bike subsidies are more cost-effective than EV subsidies https://ggwash.org/view/88025/analysis-e-bike-subsidies-are-more-cost-effective-than-ev-subsidies

Ride Report Blog: 8 New Insights from Denver's EBike Incentive Program https://www-ridereport-com.cdn.ampproject.org/c/s/www.ridereport.com/blog/ebike-inventive-programs?hs_amp=true