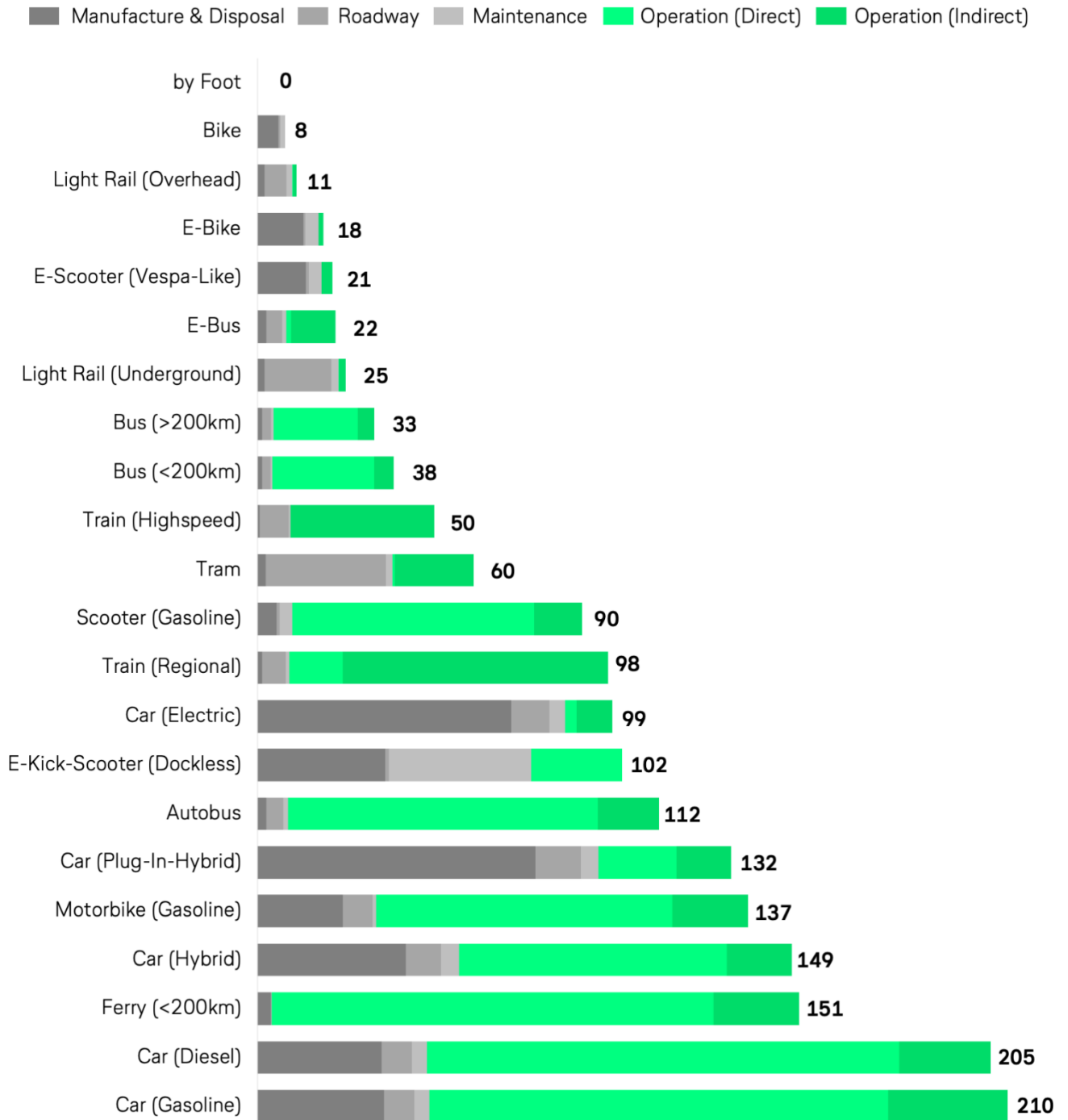


# Ranking urban transport modes

## Average carbon emissions by transport type (in gram per pkm)



Sources: Lufthansa Innovation Hub Analysis, TNMT.com, press and various research studies – see extra Airtable <https://tnmt.com/infographics/carbon-emissions-by-transport-type/>

## Definitions

**pkm** Passenger-kilometer, the unit of measurement representing the transport of one passenger by a defined mode of transit over one kilometer.

**Operation (direct)** The environmental impact caused by the direct operation of the vehicle is recorded. For example, direct emissions at the exhaust pipe, abrasion emissions from brake linings, wheels, road and overhead lines (for railways).

**Operation (indirect)** The environmental impact of indirect operation is determined, which primarily includes the provision of energy. This includes processes from energy extraction from the environment to delivery to the tank ("well-to-tank"). In the case of electrically-powered vehicles, the provision of energy comprises the processes of electricity production in the power plant via transport in high-voltage lines and transformation into the battery.

**Maintenance** All the processes required to keep the vehicle roadworthy during its service life are counted. For example, changing the tires of cars and replacing consumables in railway trains. E-Vehicles, battery replacement is fully included in vehicle production and not in vehicle maintenance.

**Manufacture & Disposal** This category includes all processes that affect the manufacturing of the vehicle that are not included in maintenance. In addition to the pure material costs, the energy costs and operating emissions of the production facilities are considered, as well as the professional disposal of the vehicles after the average service life has expired.

**Roadway** The construction, maintenance, and disposal of all types of tracks are counted. In the case of road transport, these include roads, car parks and major infrastructures such as tunnels or bridges. In the case of rail traffic, entire lines, safety walls, bridges, and tunnels fall into this cluster while in the case of air traffic, the airport's infrastructure is considered.

## Assumptions, Selected Sources

**Electricity mix** The German electricity mix 2020 is used as a basis (in % of total):  
Lignite 16.8%, Hard coal 7.3%, Nuclear energy 12.5%, Natural gas 12.1%, Renewables 50.5%  
Renewable mix: Wind energy 27%, , photovoltaics 10.4%, biomass 9.3%, Hydropower 3.7%

### **By Foot**

N/A

### **Bike**

Weight: 17kg

Vehicle weight incl. driver: 92kg

Lifetime of parts: 15,000km

It is assumed that parts of the average bike need to be replaced prematurely, e.g. 50% of plastic parts and 5% of steel and aluminum parts every 15,000km.

<https://www.sciencedirect.com/science/article/pii/S2352146515002811>

<https://slate.com/technology/2011/08/how-soon-does-a-bike-pay-back-its-initial-carbon-footprint.html>

[https://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/8483/Duke\\_MP\\_Published.pdf](https://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/8483/Duke_MP_Published.pdf)  
[https://www.researchgate.net/publication/282317121\\_Cycling\\_Mobility\\_-\\_A\\_Life\\_Cycle\\_Assessment\\_Based\\_Approach](https://www.researchgate.net/publication/282317121_Cycling_Mobility_-_A_Life_Cycle_Assessment_Based_Approach)

**Light Rail (Overhead)** (example: S-Bahn overhead train in Berlin, Hamburg, Munich, or Frankfurt):

Load factor: 19%

<https://bit.ly/3bf04GJ>

<https://www.umweltbundesamt.de/umwelttipps-fuer-den-alltag/mobilitaet/bus-bahn-fahren#hintergrund>

[https://www.researchgate.net/publication/278419415\\_Life\\_cycle\\_inventories\\_of\\_transport\\_services](https://www.researchgate.net/publication/278419415_Life_cycle_inventories_of_transport_services)

[https://books.google.com/books/about/%C3%96koinventar\\_Transporte.html?id=XjKgAgAACAAJ](https://books.google.com/books/about/%C3%96koinventar_Transporte.html?id=XjKgAgAACAAJ)

[https://www.plattformeco2.ch/portal/documents/10279/16917/Ecopassenger\\_Methodology\\_Report.pdf/6c5f0f36-f2e2-446f-9c5d-d522299f8caa](https://www.plattformeco2.ch/portal/documents/10279/16917/Ecopassenger_Methodology_Report.pdf/6c5f0f36-f2e2-446f-9c5d-d522299f8caa)

[https://www.umweltbundesamt.de/themen/verkehr-laerm/emissionsdaten#verkehrsmittelvergleich\\_personenverkehr](https://www.umweltbundesamt.de/themen/verkehr-laerm/emissionsdaten#verkehrsmittelvergleich_personenverkehr)

### **E-bike**

Lifetime: 15,000km;

Energy consumption: 2.25 kWh/100km

Battery weight: 3.5kg

Number of batteries over the lifespan of 15,000km: 1.65 batteries

Weight of electric motor: 4.4kg

Total weight of e-bike: 25kg

It is assumed that parts of the bike need to be replaced prematurely. 50% of plastic parts and 5% of steel and aluminum parts every 15,000km.

<https://bit.ly/3qwlEwX>

[https://ebikepursuits.com/how-much-does-an-ebike-battery-weigh/#:~:text=Electric%20bike%20batteries%20typically%20weigh,12.6%20pounds%20\(5.7kg\)g](https://ebikepursuits.com/how-much-does-an-ebike-battery-weigh/#:~:text=Electric%20bike%20batteries%20typically%20weigh,12.6%20pounds%20(5.7kg)g)

<https://enveurope.springeropen.com/articles/10.1186/s12302-020-00307-8>

<https://www.sciencedirect.com/science/article/pii/S1361920915001315>

<https://www.sciencedirect.com/science/article/pii/S2352146515002811>

<https://slate.com/technology/2011/08/how-soon-does-a-bike-pay-back-its-initial-carbon-footprint.html>

[https://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/8483/Duke\\_MP\\_Published.pdf](https://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/8483/Duke_MP_Published.pdf)

[https://www.researchgate.net/publication/282317121\\_Cycling\\_Mobility\\_-\\_A\\_Life\\_Cycle\\_Assessment\\_Based\\_Approach](https://www.researchgate.net/publication/282317121_Cycling_Mobility_-_A_Life_Cycle_Assessment_Based_Approach)

**E-Scooter** (example: Vespa Elettrica):

Weight: 130kg;

Weight electric motor: 12kg

Weight of batteries: 11kg

Energy consumption: 4 kWh/100km

Load Factor: 1.3

Number of batteries over the life span of 50,000km: 1.5

Charging cycles per battery: 600

<http://esu-services.ch/fileadmin/download/leuenberger-2010-TwoWheelVehicles.pdf>

<https://www.verivox.de/elektromobilitaet/themen/e-scooter->

[stromverbrauch/#:~:text=Auf%20100%20Kilometer%20verbrauchen%20die,die%20Akkukapazit%20eines%20E%20Scooters](https://www.verivox.de/elektromobilitaet/themen/e-scooter-stromverbrauch/#:~:text=Auf%20100%20Kilometer%20verbrauchen%20die,die%20Akkukapazit%20eines%20E%20Scooters)

<https://www.techstage.de/ratgeber/Kaufberatung-Elektroller-bis-45-km-h->

[4457945.html#:~:text=Herausnehmbare%20Lithium%20Ionen%20DAkkus%20wiegen,Reichweite%20durch%20Energier%20C%20Bckgewinnung%20beim%20Bremsen](https://www.techstage.de/ratgeber/Kaufberatung-Elektroller-bis-45-km-h-4457945.html#:~:text=Herausnehmbare%20Lithium%20Ionen%20DAkkus%20wiegen,Reichweite%20durch%20Energier%20C%20Bckgewinnung%20beim%20Bremsen)

<https://www.eurotransport.de/artikel/auslastung-des-oe-pnv-22-prozent-im-schnitt->

[10656410.html#:~:text=Aufgeteilt%20auf%20die%20einzelnen%20Bef%20C%20B6rderungsmittel,waren%20zu%2018%20Prozent%20besetzt](https://www.eurotransport.de/artikel/auslastung-des-oe-pnv-22-prozent-im-schnitt-10656410.html#:~:text=Aufgeteilt%20auf%20die%20einzelnen%20Bef%20C%20B6rderungsmittel,waren%20zu%2018%20Prozent%20besetzt)

### **E-Bus**

Energy consumption: 3 kWh/100km

Load Factor: 22%

Life span of bus: 17 years

[https://www.destatis.de/DE/Presse/Pressemitteilungen/Zahl-der-Woche/2019/PD19\\_04\\_p002.html](https://www.destatis.de/DE/Presse/Pressemitteilungen/Zahl-der-Woche/2019/PD19_04_p002.html)

[https://www.researchgate.net/publication/278419415\\_Life\\_cycle\\_inventories\\_of\\_transport\\_services](https://www.researchgate.net/publication/278419415_Life_cycle_inventories_of_transport_services)

[https://www.researchgate.net/publication/286636282\\_Real-](https://www.researchgate.net/publication/286636282_Real-)

[world\\_performance\\_of\\_battery\\_electric\\_buses\\_and\\_their\\_life-cycle\\_benefits\\_with\\_respect\\_to\\_energy\\_consumption\\_and\\_carbon\\_dioxide\\_emissions](https://www.researchgate.net/publication/286636282_Real-world_performance_of_battery_electric_buses_and_their_life-cycle_benefits_with_respect_to_energy_consumption_and_carbon_dioxide_emissions)

**Light Rail (Underground)** (example: U-Bahn underground train in Berlin, Hamburg, Munich, or Frankfurt):

Load factor: 19%

<https://bit.ly/3bf04GJ>

<https://www.umweltbundesamt.de/umwelttipps-fuer-den-alltag/mobilitaet/bus-bahn-fahren#hintergrund>

[https://www.researchgate.net/publication/278419415\\_Life\\_cycle\\_inventories\\_of\\_transport\\_services](https://www.researchgate.net/publication/278419415_Life_cycle_inventories_of_transport_services)

[https://books.google.com/books/about/%20C%2096koinventar\\_Transporte.html?id=XjKgAgAACAAJ](https://books.google.com/books/about/%20C%2096koinventar_Transporte.html?id=XjKgAgAACAAJ)

[https://www.plattformeco2.ch/portal/documents/10279/16917/Ecopassenger\\_Methodology\\_Report.pdf/6c5f0f36-f2e2-446f-9c5d-d522299f8caa](https://www.plattformeco2.ch/portal/documents/10279/16917/Ecopassenger_Methodology_Report.pdf/6c5f0f36-f2e2-446f-9c5d-d522299f8caa)

<https://www.umweltbundesamt.de/themen/verkehr->

[laerm/emissionsdaten#verkehrsmittelvergleich\\_personenverkehr](https://www.umweltbundesamt.de/themen/verkehr-laerm/emissionsdaten#verkehrsmittelvergleich_personenverkehr)

**Bus (>200km)** (example: FlixBus):

Load Factor: 60%

Life span of bus: 12.5 years

Consumption: 30 liter diesel/100km

<https://de.statista.com/statistik/daten/studie/470768/umfrage/fernbusse-in-deutschland-auslastung/>

[https://www.researchgate.net/publication/278419415\\_Life\\_cycle\\_inventories\\_of\\_transport\\_services](https://www.researchgate.net/publication/278419415_Life_cycle_inventories_of_transport_services)

<https://www.umweltbundesamt.de/themen/verkehr->

[laerm/emissionsdaten#verkehrsmittelvergleich\\_personenverkehr](https://www.umweltbundesamt.de/themen/verkehr-laerm/emissionsdaten#verkehrsmittelvergleich_personenverkehr)

**Bus (<200km)**

Load Factor: 64%

Life span of bus: 12.5 years

Consumption: 42 liter diesel/100km

<https://www.umweltbundesamt.de/umwelttipps-fuer-den-alltag/mobilitaet/bus-bahn-fahren#hintergrund/>

[https://www.researchgate.net/publication/278419415\\_Life\\_cycle\\_inventories\\_of\\_transport\\_services](https://www.researchgate.net/publication/278419415_Life_cycle_inventories_of_transport_services)

[https://www.umweltbundesamt.de/themen/verkehr-laerm/emissionsdaten#verkehrsmittelvergleich\\_personenverkehr](https://www.umweltbundesamt.de/themen/verkehr-laerm/emissionsdaten#verkehrsmittelvergleich_personenverkehr)

**Train (highspeed)** (example: ICE high-speed train in Germany):

Energy consumption: 0.084 kWh/pkm

Load Factor: 56.1%

<https://link.springer.com/article/10.1007/BF02978431>

<https://de.statista.com/statistik/daten/studie/162886/umfrage/auslastung-der-zuege-der-deutschen-bahn-im-fernverkehr-seit-2006/>

[https://www.researchgate.net/publication/278419415\\_Life\\_cycle\\_inventories\\_of\\_transport\\_services](https://www.researchgate.net/publication/278419415_Life_cycle_inventories_of_transport_services)

[https://www.umweltbundesamt.de/themen/verkehr-laerm/emissionsdaten#verkehrsmittelvergleich\\_personenverkehr](https://www.umweltbundesamt.de/themen/verkehr-laerm/emissionsdaten#verkehrsmittelvergleich_personenverkehr)

**Tram** (example: Tram in Berlin):

Load factor: 18%

Life span: 30 years

Energy consumption: 4.75 kWh/100km

<https://bit.ly/3bf04GJ>

<https://www.eurotransport.de/artikel/auslastung-des-oepnv-22-prozent-im-schnitt-10656410.html#:~:text=Aufgeteilt%20auf%20die%20einzelnen%20Bef%C3%B6rderungsmittel,waren%20zu%2018%20Prozent%20besetzt>

<https://www.umweltbundesamt.de/umwelttipps-fuer-den-alltag/mobilitaet/bus-bahn-fahren#hintergrund>

[https://www.researchgate.net/publication/278419415\\_Life\\_cycle\\_inventories\\_of\\_transport\\_services](https://www.researchgate.net/publication/278419415_Life_cycle_inventories_of_transport_services)

**Scooter (Gasoline)** (example: Vespa Piaggio):

Load factor: 1.3

Consumption: 3 liters/100km

Cubic capacity: 50cm<sup>3</sup>

Life span: 50,000km

Weight: 90kg

<https://help.nova-motors.de/hc/de/articles/214101765-Wie-hoch-ist-der-Benzinverbrauch-bei-einem-Motorroller-#:~:text=Der%20Verbrauch%20liegt%20bei%2049ccm,Fahrweise%20oder%20dem%20Gel%C3%A4nde%20abh%C3%A4ngig>

<https://esu-services.ch/fileadmin/download/leuenberger-2010-TwoWheelVehicles.pdf>

**Train (Regional)** (example: Regionalbahn in Germany such as RB or RE):

Load factor: 26%

Energy consumption: 0.164 kWh/pkm

<https://bit.ly/3bf04GJ>

<https://www.eurotransport.de/artikel/auslastung-des-oe-pnv-22-prozent-im-schnitt-10656410.html#:~:text=Aufgeteilt%20auf%20die%20einzelnen%20Bef%C3%B6rderungsmittel,waren%20zu%2018%20Prozent%20besetzt>

<https://www.umweltbundesamt.de/umwelttipps-fuer-den-alltag/mobilitaet/bus-bahn-fahren#hintergrund>

[https://www.researchgate.net/publication/278419415\\_Life\\_cycle\\_inventories\\_of\\_transport\\_services](https://www.researchgate.net/publication/278419415_Life_cycle_inventories_of_transport_services)

**Car (Electric)** (example: Tesla Model 3):

The e-car is a mid-size car, which is equipped with an electric motor and lithium-ion batteries, with a total weight of 1,769kg (state of the art).

A load factor of 1.5 people was applied.

The vehicle was supplemented with an electric motor weighing 104 kg, as well as a lithium-ion battery.

The total battery has a total weight of 480kg.

The average energy consumption per 100km is 15kWh.

Battery life: As lithium-ion batteries for electric vehicles have only recently been introduced to the market, manufacturers have little experience and hard data in terms of overall battery life.

According to laboratory tests, most batteries are expected to have a service life of about 150,000 km, but under real conditions, the batteries sometimes show a lower service life. It is assumed that the battery is replaced 0.5 times in the life of the vehicle (150,000 km).

[http://www.mobilitaet-in-deutschland.de/pdf/MiD2017\\_Tabellenband\\_Deutschland.pdf](http://www.mobilitaet-in-deutschland.de/pdf/MiD2017_Tabellenband_Deutschland.pdf)

<https://www.forschungsinformationssystem.de/servlet/is/499566/>

<https://www.energuide.be/en/questions-answers/how-much-power-does-an-electric-car-use/212/>

[https://de.wikipedia.org/wiki/Tesla\\_Model\\_3](https://de.wikipedia.org/wiki/Tesla_Model_3)

[https://en.wikipedia.org/wiki/Tesla\\_Model\\_3#:~:text=The%20Standard%20Range%20version%20carries,density%20of%20150%20Wh%2Fkg](https://en.wikipedia.org/wiki/Tesla_Model_3#:~:text=The%20Standard%20Range%20version%20carries,density%20of%20150%20Wh%2Fkg)

<https://www.statista.com/statistics/960121/sales-of-all-electric-vehicles-worldwide-by-model/>

<https://www.topspeed.com/cars/car-news/stop-worrying-about-battery-life-if-you-own-a-tesla-model-3-ar185236.html#:~:text=The%20Tesla%20Model%203%20is%20Built%20For%20Longevity&text=Current%20battery%20modules%20should%20last,%245k%20to%20%247k.&text=Musk%20is%20stating%20that%20the,the%20equivalent%20of%201%2C500%20cycles>

[https://db.ecoinvent.org/reports/18\\_II\\_Electronics\\_modules.pdf?area=463ee7e58cbf8](https://db.ecoinvent.org/reports/18_II_Electronics_modules.pdf?area=463ee7e58cbf8)

<https://pubs.acs.org/doi/10.1021/es103607c>

<https://www.mdpi.com/2313-0105/5/2/48>

<https://www.sciencedirect.com/science/article/pii/S2212827115005004>

<https://journals.sagepub.com/doi/abs/10.1177/0734242X20966637>

<https://www.transportenvironment.org/sites/te/files/publications/TE%20-%20draft%20report%20v04.pdf>

[https://www.researchgate.net/publication/341933934\\_Life\\_Cycle\\_Assessment\\_of\\_Electric\\_Vehicle\\_Batteries\\_An\\_Overview\\_of\\_Recent\\_Literature](https://www.researchgate.net/publication/341933934_Life_Cycle_Assessment_of_Electric_Vehicle_Batteries_An_Overview_of_Recent_Literature)

Life Cycle Inventories of Transport Services

Klimaschutz im Verkehrssektor: Die Batterie verhagelt E-Autos die CO2-Bilanz

**E-Kick-Scooter (dockless)** (example: Tier, Bird, Lime):

Load Factor: 1

Life span: 540 days; 1,782 rides

Weight: 13kg

Frame: Aerospace-grad aluminum

Tires: 22cm rubber

Power: 30 lithium-ion batteries; capacity of 335 watthours

Weight of batteries: 2kg

Weight of tires: 1kg

Remaining weight: 10kg

Avg. trip duration: 18 minutes

Avg. rides per day: 3.3 trips

[https://image-src.bcg.com/Images/BCG-The-Promise-and-Pitfalls-of-E-Scooter%20Sharing-May-2019\\_tcm81-220107.pdf](https://image-src.bcg.com/Images/BCG-The-Promise-and-Pitfalls-of-E-Scooter%20Sharing-May-2019_tcm81-220107.pdf)

<https://chesterenergyandpolicy.com/2019/01/28/its-a-bird-its-a-lime-its-dockless-scooters-but-can-these-electric-powered-mobility-options-be-considered-sustainable-using-life-cycle-analysis/>

<https://phys.org/news/2019-07-electric-scooters-eco-friendly.html>

<https://qz.com/1561654/how-long-does-a-scooter-last-less-than-a-month-louisville-data-suggests/>

[https://docs.google.com/spreadsheets/d/1c\\_4cGoL0PNVTg2XEivPIsd12\\_5WeKcZFv4C4043euVw/edit#gid=1154576549](https://docs.google.com/spreadsheets/d/1c_4cGoL0PNVTg2XEivPIsd12_5WeKcZFv4C4043euVw/edit#gid=1154576549)

<http://hig.diva-portal.org/smash/get/diva2:1347041/FULLTEXT01.pdf>

<https://publications.parliament.uk/pa/cm5801/cmselect/cmtrans/255/25509.htm>

<https://iopscience.iop.org/article/10.1088/1748-9326/ab2da8>

<https://youmatter.world/en/sustainable-mobility-electric-scooters-28897/#:~:text=According%20to%20the%20scientists%20who,over%20their%20entire%20life%20cycle>

**Autobus** (example: typical inner-city buses in Berlin, Hamburg, Munich, or Frankfurt):

Load factor: 19%

<https://www.umweltbundesamt.de/umwelttipps-fuer-den-alltag/mobilitaet/bus-bahn-fahren#hintergrund>

[https://www.researchgate.net/publication/278419415\\_Life\\_cycle\\_inventories\\_of\\_transport\\_services](https://www.researchgate.net/publication/278419415_Life_cycle_inventories_of_transport_services)

[https://books.google.com/books/about/%C3%96koinventar\\_Transporte.html?id=XjKgAgAACAAJ](https://books.google.com/books/about/%C3%96koinventar_Transporte.html?id=XjKgAgAACAAJ)

[https://www.plattformeco2.ch/portal/documents/10279/16917/Ecopassenger\\_Methodology\\_Report.pdf/6c5f0f36-f2e2-446f-9c5d-d522299f8caa](https://www.plattformeco2.ch/portal/documents/10279/16917/Ecopassenger_Methodology_Report.pdf/6c5f0f36-f2e2-446f-9c5d-d522299f8caa)

**Car (Plug-in-Hybrid)**

Load factor: 1.5

Energy consumption: 16 kWh/100km

<https://www.mdpi.com/2032-6653/11/2/31/pdf>

<https://www.cmu.edu/me/ddl/publications/2009-TRB-Shiau-Samaras-Michalek-PHEV.pdf>

<https://www.carsdirect.com/green-cars/3-tips-to-maximize-hybrid-car-battery-life#:~:text=The%20batteries%20in%20modern%20hybrids,because%20it%20just%20wears%20out.>  
<https://cecas.clemson.edu/~sonori/Publications/536.pdf>  
<https://www.sciencedirect.com/topics/engineering/plug-in-hybrid>  
[https://en.wikipedia.org/wiki/Toyota\\_Prius\\_Plug-in\\_Hybrid](https://en.wikipedia.org/wiki/Toyota_Prius_Plug-in_Hybrid)  
[https://www.mobilityhouse.com/int\\_en/knowledge-center/charging-time-summary](https://www.mobilityhouse.com/int_en/knowledge-center/charging-time-summary)  
[https://www.isi.fraunhofer.de/content/dam/isi/dokumente/sustainability-innovation/2015/WP01-2015\\_Real-world-fuel-economy-and-CO2-emissions-of-PHEV\\_Ploetz-Funke-Jochem-Patrick.pdf](https://www.isi.fraunhofer.de/content/dam/isi/dokumente/sustainability-innovation/2015/WP01-2015_Real-world-fuel-economy-and-CO2-emissions-of-PHEV_Ploetz-Funke-Jochem-Patrick.pdf)  
<https://www.forschungsinformationssystem.de/servlet/is/499566/>  
[http://www.mobilitaet-in-deutschland.de/pdf/MiD2017\\_Tabellenband\\_Deutschland.pdf](http://www.mobilitaet-in-deutschland.de/pdf/MiD2017_Tabellenband_Deutschland.pdf)  
[https://www.researchgate.net/publication/278419415\\_Life\\_cycle\\_inventories\\_of\\_transport\\_services](https://www.researchgate.net/publication/278419415_Life_cycle_inventories_of_transport_services)

### **Motorbike (Gasoline)**

Load Factor: 1.3%

Consumption: 4.4 liter/100km

Weight: 318kg

<http://www.fema-online.eu/website/index.php/2016/05/02/yes-motorcycles-use-less-fuel-than-cars-heres-the-proof/>

<https://www.nadaguides.com/Motorcycles/shopping-guides/how-much-do-motorcycles-weigh#:~:text=Average%20Motorcycle%20Weights&text=Some%20sources%20say%20the%20E2%80%9Coverage,bike%2C%20or%20something%20else%20entirely>

### **Car (Hybrid)**

Load Factor: 1.5

Consumption: 4.5 liter/100km

Weight: 1,528kg

Battery weight: 53.5kg

Energy consumption: 9.8kWh/100km

Battery life: As lithium-ion batteries for electric vehicles have only recently been introduced to the market, manufacturers have little experience and hard data in terms of overall battery life.

According to laboratory tests, most batteries are expected to have a service life of about 150,000 km, but under real conditions, the batteries sometimes show a lower service life. It is assumed that the battery is replaced 0.5 times in the life of the vehicle (150,000 km).

[http://www.mobilitaet-in-deutschland.de/pdf/MiD2017\\_Tabellenband\\_Deutschland.pdf](http://www.mobilitaet-in-deutschland.de/pdf/MiD2017_Tabellenband_Deutschland.pdf)

<https://www.forschungsinformationssystem.de/servlet/is/499566/>

<https://www.guideautoweb.com/en/makes/toyota/prius/2019/specifications/base>

<https://www.toyota.ca/toyota/en/vehicles/prius/models-specifications>

[https://www.isi.fraunhofer.de/content/dam/isi/dokumente/cct/2020/Fact\\_check\\_Batteries\\_for\\_electric\\_cars.pdf](https://www.isi.fraunhofer.de/content/dam/isi/dokumente/cct/2020/Fact_check_Batteries_for_electric_cars.pdf)

<https://www.caranddriver.com/research/a32768969/hybrid-battery/>

**Ferry (<200km)** (example: Passenger ferries on the Rhine or Elbe river):

Load factor: 45%



Consumption: 9.4g/tkm heavy fuel oil

Weight: 7.5mt

[https://www.researchgate.net/publication/278419415\\_Life\\_cycle\\_inventories\\_of\\_transport\\_services](https://www.researchgate.net/publication/278419415_Life_cycle_inventories_of_transport_services)  
[https://www.epd.gov.hk/eia/register/report/eiareport/eia\\_2172013/EIA/EIA\\_Appendices/Appendix%203.6.pdf](https://www.epd.gov.hk/eia/register/report/eiareport/eia_2172013/EIA/EIA_Appendices/Appendix%203.6.pdf)

**Car (Diesel)** mid-size car (VW Golf)

Load factor: 1.5

Emissions category: EURO 5

Consumption: 7.0 liter/100km

Weight: 1,400kg

<https://youmatter.world/en/plane-or-cars-which-means-of-transport-pollutes-the-most/>  
[https://doc.rero.ch/record/320344/files/11367\\_2005\\_Article\\_7013.pdf](https://doc.rero.ch/record/320344/files/11367_2005_Article_7013.pdf)  
<https://www.hbefa.net/e/documents/reports.html>  
[http://www.mobilitaet-in-deutschland.de/pdf/MiD2017\\_Tabellenband\\_Deutschland.pdf](http://www.mobilitaet-in-deutschland.de/pdf/MiD2017_Tabellenband_Deutschland.pdf)  
<https://www.forschungsinformationssystem.de/servlet/is/499566/>  
<https://de.statista.com/statistik/daten/studie/484054/umfrage/durchschnittsverbrauch-pkw-in-privaten-haushalten-in-deutschland/#:~:text=Der%20durchschnittliche%20Kraftstoffverbrauch%20von%20Personenkraftwagen,Kraftstoff%20f%C3%BCr%20die%20gleiche%20Strecke>  
[https://www.bmvi.de/SharedDocs/DE/Publikationen/G/verkehr-in-zahlen-2019-pdf.pdf?\\_\\_blob=publicationFile](https://www.bmvi.de/SharedDocs/DE/Publikationen/G/verkehr-in-zahlen-2019-pdf.pdf?__blob=publicationFile)  
<https://de.statista.com/statistik/daten/studie/238004/umfrage/gewicht-von-pkw-nach-autoherstellern/>  
[http://eupocketbook.org/wp-content/uploads/2020/12/ICCT\\_Pocketbook\\_2020\\_Web.pdf](http://eupocketbook.org/wp-content/uploads/2020/12/ICCT_Pocketbook_2020_Web.pdf)  
[https://www.researchgate.net/publication/278419415\\_Life\\_cycle\\_inventories\\_of\\_transport\\_services](https://www.researchgate.net/publication/278419415_Life_cycle_inventories_of_transport_services)  
<https://www.hbefa.net/e/documents/reports.html>  
<https://eur-lex.europa.eu/legal-content/de/TXT/?uri=CELEX%3A32007R0715>

**Car (Gasoline)** mid-size car (VW Golf)

Load factor: 1.5

Emissions category: EURO 5

Consumption: 7.8 liter/100km

Weight: 1,400kg

<https://youmatter.world/en/plane-or-cars-which-means-of-transport-pollutes-the-most/>  
[https://doc.rero.ch/record/320344/files/11367\\_2005\\_Article\\_7013.pdf](https://doc.rero.ch/record/320344/files/11367_2005_Article_7013.pdf)  
<https://www.hbefa.net/e/documents/reports.html>  
[http://www.mobilitaet-in-deutschland.de/pdf/MiD2017\\_Tabellenband\\_Deutschland.pdf](http://www.mobilitaet-in-deutschland.de/pdf/MiD2017_Tabellenband_Deutschland.pdf)  
<https://www.forschungsinformationssystem.de/servlet/is/499566/>  
<https://de.statista.com/statistik/daten/studie/484054/umfrage/durchschnittsverbrauch-pkw-in-privaten-haushalten-in-deutschland/#:~:text=Der%20durchschnittliche%20Kraftstoffverbrauch%20von%20Personenkraftwagen,Kraftstoff%20f%C3%BCr%20die%20gleiche%20Strecke>  
[https://www.bmvi.de/SharedDocs/DE/Publikationen/G/verkehr-in-zahlen-2019-pdf.pdf?\\_\\_blob=publicationFile](https://www.bmvi.de/SharedDocs/DE/Publikationen/G/verkehr-in-zahlen-2019-pdf.pdf?__blob=publicationFile)

<https://de.statista.com/statistik/daten/studie/238004/umfrage/gewicht-von-pkw-nach-autoherstellern/>  
[http://eupocketbook.org/wp-content/uploads/2020/12/ICCT\\_Pocketbook\\_2020\\_Web.pdf](http://eupocketbook.org/wp-content/uploads/2020/12/ICCT_Pocketbook_2020_Web.pdf)  
[https://www.researchgate.net/publication/278419415\\_Life\\_cycle\\_inventories\\_of\\_transport\\_services](https://www.researchgate.net/publication/278419415_Life_cycle_inventories_of_transport_services)  
<https://www.hbefa.net/e/documents/reports.html>  
<https://eur-lex.europa.eu/legal-content/de/TXT/?uri=CELEX%3A32007R0715>