RIVIAN

Version 1.0

Electric Delivery Van Carbon Footprint

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Introduction

Switching to an electric vehicle is one of the highest-impact actions that commercial fleet operators can take to support solutions to the climate crisis. At the same time, we recognize that electrifying transportation alone is not sufficient to meet the challenge.

Introduction

Rivian was founded to help individuals and businesses adopt cleaner mobility solutions. We use life cycle assessment (LCA) to help us understand the carbon footprint of our first-ever vehicles, develop strategies to improve those footprints, and monitor our progress over time. Our carbon footprints consider the cradle-to-grave greenhouse gas (GHG) emissions of the vehicle, which capture materials and supply chain, onsite production and logistics, operation and service, and, ultimately, decommissioning phases. This means evaluating thousands of individual parts and dozens of electricity grids, and conducting countless discussions with our engineering, design, procurement, and other teams in an effort to develop footprints that accurately reflect our vehicles. The result is a study that we believe sets the bar for depth and comprehensiveness for electric vehicles.

This report describes the carbon footprint of the Rivian Electric Delivery Van (EDV) in 2023. There are two variants of the EDV that vary in size: EDV 700 and EDV 500. Both vehicles are a part of Rivian's commercial program. The EDV is designed to push the boundaries of the electric vehicle market and create a platform for delivery vehicles powered only by electricity.

This report, coupled with the *Carbon Footprint Methodology Report*[1], conforms with ISO 14040 and 14044[2] standards. We use an attributional carbon footprinting approach and assess a single midpoint impact category: global warming potential (GWP) over a 100-year time frame. The characterization factors for greenhouse gases are established by the sixth assessment report (AR6) from the Intergovernmental Panel on Climate Change (IPCC), which includes climate-carbon feedbacks.

The functional units of this study are the base models of the EDV 700 and EDV 500 in 2023 driven 330,000 miles over a 10-year period. The results of this study are presented in grams of carbon dioxide equivalents per mile (g CO_2e/mi). Unlike using an absolute carbon footprint (e.g., MT CO_2e), a metric normalized by durability captures the sustainability benefits of long-lasting vehicles.

> **We use life cycle assessment (LCA) to help us understand the carbon footprint of our first-ever vehicles, develop strategies to improve those footprints, and monitor our progress over time.**

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[1] Rivian Methodology Report
[2] ISO 14044:2006 Environmental management – Life cycle assessment – Requirements and guidelines" and ISO 14040:2006 "Environmental management – Life cycle assessment – Principles and framework"

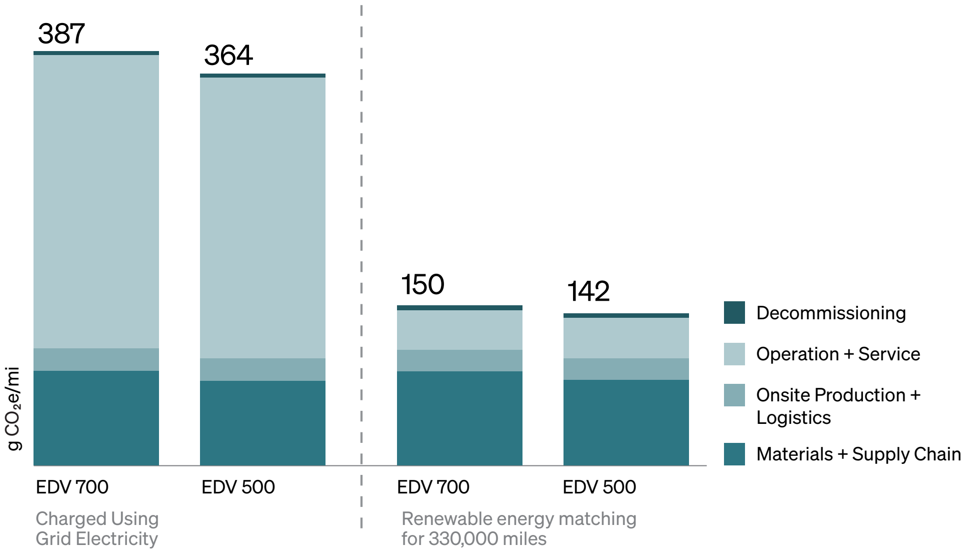
EDV Carbon Footprint

The EDV 700 and EDV 500 in 2023, driven in the United States with an assumed 3% year-over-year improvement in the carbon intensity of grid electricity, have carbon footprints of 387 g CO_2e/mi and 364 g CO_2e/mi respectively over 330,000 miles.

EDV Carbon Footprint

Figure 1 shows the baseline carbon footprints of each EDV along with a scenario that uses renewable energy for charging across all 330,000 miles. When renewable energy is used for charging, the carbon footprint is over 60% lower than that of the baseline scenarios at 150 and 142 g CO_2e/mi.

Figure 1
EDV carbon footprint overview. The baseline carbon footprint (left): is presented alongside an alternative scenario (right): renewable matching for 330,000 miles



Creating opportunities for vehicles to leverage renewable energy is a core part of Rivian's sustainability strategy. Our objective is to find ways to maximize the generation of renewable energy for every Rivian vehicle deployed, reducing the operational carbon footprint of the consumer and commercial fleets. One example is our Rivian Service Vehicles, which are built on our commercial platform, Rivian Commercial Van, and whose charging is part of Rivian's renewable energy plans. Both the EDV and Rivian Service Vehicles are a part of the Rivian Commercial Van platform.

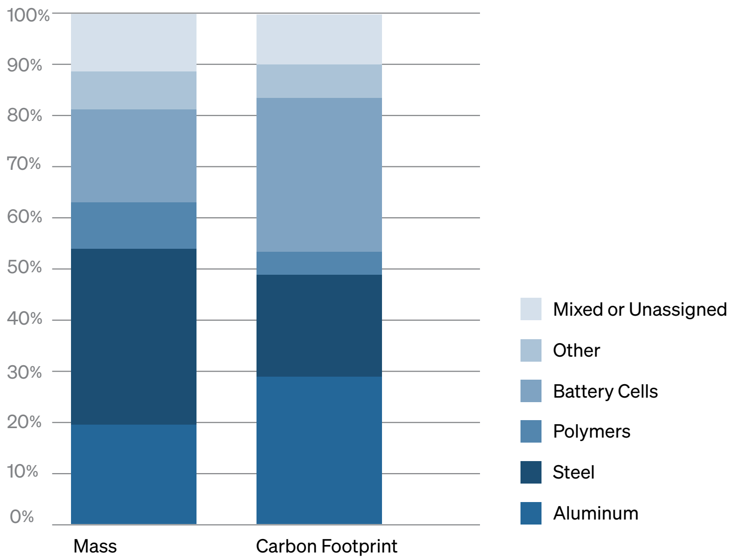
2.1 Materials and Supply Chain

The carbon footprint of the materials and supply chain includes the material mining and refining along with upstream manufacturing.

The gross vehicle weight rating of the EDV 500 and EDV 700 is 4241 and 4309 kg, respectively. A bill of materials (BoM) is extracted automatically from our product lifecycle management (PLM) system through a script that bins thousands of material designations into roughly 60 material types, such as polyamides, hot-rolled steel, copper, and many others. Several material types are aggregations of mixed or unassigned materials, which are common among complex parts and/or complex supply chains. Parts with mixed and unassigned materials that are greater than 0.1% of the total vehicle mass are investigated individually through discussions with design teams, review of engineering drawings, and other efforts to gather more specific material information. A notable part investigation for the EDV was the drive unit. Generally, our target is to reduce the mixed and unassigned materials to less than 15% of the overall vehicle mass; for both EDVs, the total is 12%.

Figure 2 shows the material composition and GHG emissions of the EDV 500, which closely resembles that of the EDV 700, broken into major material categories.

Figure 2
EDV 500 mass and carbon footprint breakdown by material category



Materials and Supply Chain (Excluding Battery Cells)

Excluding battery cells, the GHG emissions from the materials and supply chain phases are 59 g CO_2e/mi (EDV 500) and 67 g CO_2e/mi (EDV 700). For mixed and unassigned materials, a weighted average of the known materials is used to estimate the composition and apply the corresponding carbon intensity factors.

As shown in Figure 2, apart from battery cells, steel and aluminum contribute the most to the carbon footprint of the material and supply chain stages of the EDVs. Based on feedback from our suppliers, we estimate the recycled content in our sheet aluminum and steel is 18% and 26%, respectively. Other types of steel are assumed to have a recycled content of 12%, in line with the average recycled content in cold-rolled coil, per Worldsteel[3] data in the Sphera Managed LCA Content (MLC)[4] database. This is also expected to be a minimum, as all steel will likely contain some recycled content. For cast and extruded aluminum, we assume 40% and 35% recycled content, respectively, which is half of the average recycled content for these semi-fabricated products in North America, as reported by the Aluminum Association[5]. In practice, steel and aluminum will likely have higher recycled content than the amounts included in this EDV study, as demonstrated by both the Aluminum Association and the American Iron and Steel Institute[6]. Rivian uses conservative assumptions to ensure that we are not accounting for lower-carbon materials until we are confident about recycled contents in those supply chains. Tracking and increasing the amount of recycled content in our vehicles is an active growth strategy at Rivian.

> **Tracking and increasing the amount of recycled content in our vehicles is an active growth strategy at Rivian.**

Battery Cells

Battery cells are explored independently of other parts in the BoM due to their complexity and importance with respect to the EDV vehicle footprints. Rivian has created a unique battery model that allows us to integrate relevant details for the cells used in the EDVs. The battery model is described in more detail in the Rivian Carbon Footprint Methodology Report.

Table 1 shows the carbon footprint of the battery by major contribution source. The total carbon footprint of the battery cells is 25 g CO_2e/mi for both EDV 500 and EDV 700. The electricity intensive activities in cell manufacturing are the largest drivers of the battery cell footprint. Following those activities, due to the highly technical nature of the materials in battery cells, the activities associated with the mining and refining of cell materials are also large drivers of the battery cell footprint.

Table 1
Carbon footprint of the battery cell materials and supply chain

Activity	Carbon Footprint (g CO_2e/mi)
Raw Cell Materials Mining and Refining	9
Cathode Powder Production	2
Cell Manufacturing	14
Upstream Transportation	<1
Total[7]	**25**

Summary of Materials and Supply Chain

The carbon footprint for materials and supply chain is 84 g CO_2e/mi (EDV 500) and 92 g CO_2e/mi (EDV 700), as shown in Table 2. This represents approximately one-fourth of the total EDV carbon footprints. The materials and supply chain (excluding battery cells) is the largest contributor at over 15% of each footprint.

Table 2
Carbon footprint of the materials and supply chain

Activity	Carbon Footprint (g CO_2e/mi)	
	EDV 500	EDV 700
Materials and Supply Chain (excluding battery cells)	59	67
Battery Cell Materials and Supply Chain	25	25
Total	**84**	**92**

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[3] Life Cycle Inventory (LCI) Study: 2020 Data Release. World Steel Association. 2021.

[4] Sphera MLC is accessed through the LCA for Experts software version 10.7

[5] The Environmental Footprint of Semi-Fabricated Aluminum Products in North America: A Life Cycle Assessment Report. The Aluminum Association. 2022.

[6] Life Cycle Inventories of North American Steel Products. American Iron and Steel Institute. 2020.

[7] Total for this and/or other tables may not add up due to rounding

2.2 Onsite Production and Logistics

GHG emissions from onsite production and logistics in Q1 of 2023 account for 20 g CO_2e/mi per vehicle, which is over 5% of the total vehicle emissions of each EDV. The primary contributor to these GHG emissions is the electricity used for onsite production. The breakdown is shown in Table 3.

Table 3
Carbon footprint of onsite production and logistics

Source	Carbon Footprint (g CO_2e/mi)
Inbound Logistics	6
Onsite Production: Scope 1 and 2	12
Onsite Production: Scope 3 Emissions	2
Outbound Logistics	1
Total	**20**

Inbound logistics

Inbound logistics include the transportation of the parts and materials from suppliers into the Rivian onsite production facilities. GHG emissions from inbound logistics include all incoming freight for materials and parts related to production at the Rivian production plant. The GHG emissions from inbound logistics are divided evenly across all vehicles produced at the plant in the first quarter (Q1) of 2023. The GHG emissions per vehicle are expected to decrease as Rivian production volume increases and we move towards steady-state operations, thus decreasing logistics associated with production ramp. Additionally, carbon factors from Sphera's MLC database are used when mass and distance data are reported in the TMS system. In the absence of mass inputs, cost data are used alongside CEDA factors from CEDA Global 4.01 to determine the GHG emissions from these parts. Comparing the mass and cost data for parts with both metrics available, we find the cost-based estimation consistently more conservative. As such, we expect that as our data improve, the GHG emissions from this stage of the product's life cycle will decrease.

Onsite Production

Production of the EDVs occurred at the Rivian production plant in Normal, Illinois. Much of the energy used at the plant is electricity and natural gas, with minor contributions from propane- and diesel-powered equipment and refrigerants. Rivian's manufacturing plant energy metering system is not equipped with sub-metering; therefore, the carbon footprint of this stage conservatively includes business activities outside of production and is divided equally across Rivian vehicles using the total number of vehicles produced in Q1 of 2023. The Normal production plant lies in the eGRID subregion SRMW; the 2020 eGRID-based Sphera MLC grid mix dataset is used as the carbon intensity for all electricity pulled from the grid. The plant is equipped with onsite solar, which supplied a portion of the electricity used for onsite production[8]. This reduced the total electricity procured from the grid and therefore reduced the carbon footprint from onsite production.

We expect that the carbon footprint of onsite production will significantly improve in future years as factory ramp-up converts to higher annual vehicle volumes. Rivian has already witnessed significantly lower per-vehicle production energy in 2023 compared with 2022. We expect that future model year vehicles will benefit from the increased production efficiency. In addition, Rivian plans to increase renewable energy procurements for Normal, which will further reduce the GHG emissions associated with onsite production.

Outbound Logistics

Outbound logistics consist of delivering finished EDVs to their point-of-use. Like inbound logistics, data are reported by our logistics team and divided across the number of Rivian vehicles produced in Q1 of 2023 to yield the carbon footprint of outbound logistics per vehicle. The following results are the same for both variants of the EDV.

We expect that the carbon footprint of onsite production will significantly improve in future years as factory ramp-up converts to higher annual vehicle volumes. Rivian has already witnessed significantly lower per-vehicle production energy in 2023 compared with 2022.

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[8] No energy attributes are sold to the grid (or any other third party). The energy produced onsite is used exclusively by Rivian.

2.3 Operation and Service

The energy used by the EDV is driven principally by propulsion efficiency, but also includes charging efficiency and passive battery drain.

Operation and Service includes GHG emissions while owners use an EDV over the 330,000 mile / 10-year period used for this report. This includes the emissions from charging the EDV and servicing key parts.

The energy used by the EDV is driven principally by propulsion efficiency, but also includes charging efficiency and passive battery drain. We determine the propulsion electricity using the EPA-reported range and the usable battery energy (UBE) for each vehicle. The EPA-reported range of the EDV 500 and EDV 700 is 161 miles and 153 miles, repectively.

The carbon intensity of the electricity grid is expected to change over the life of the vehicle. For the EDV, Rivian uses a 3% year-over-year improvement. This improvement is slightly more pessimistic than the most conservative projection from the International Energy Agency (IEA) *World Energy Outlook 2021* report[9], which relies on "stated policies" rather than pledges or other aspirational improvements. From that, the years 2025, 2030, 2040, and 2050 were used to establish the 3% year-over-year improvement rate. All GHG data, including the IEA projections, are based on Sphera's MLC database.

Rivian believes it is important to use our best understanding of how the electricity grid will change for the base cases of our vehicles. But we also acknowledge that forecasting the GHG emissions from electricity is inherently uncertain. Figure 3 shows the carbon footprint of the EDV 500 across 330,000 miles using different assumptions for the carbon intensity of the grid.

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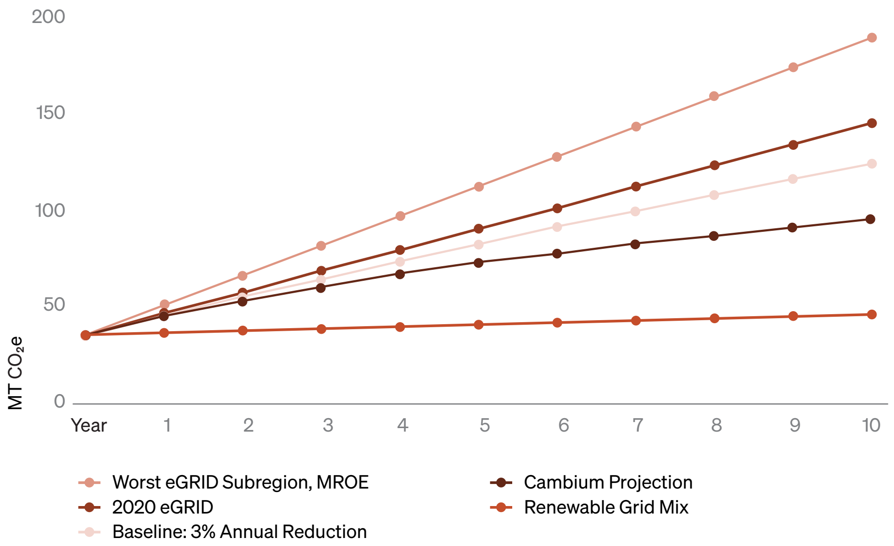
[9] https://iea.blob.core.windows.net/assets/4ed140c1-c3f3-4fd9-acae-789a4e14a23c/WorldEnergyOutlook2021.pdf

The most conservative scenario assumes the EDV is charged in the eGRID subregion with the highest carbon intensity (MROE[10]) and that the grid does not improve relative to 2020 emissions. The most optimistic scenario assumes the EDV is charged using a mix of renewable energy. Also included in the scenario is an assumption that the EDV is charged using Rivian's average electricity mix (weighted by sales in each eGRID subregion) without the IEA improvements (i.e., using the 2020 grid mix for each eGRID subregion).

Figure 3
EDV 500 cumulative carbon footprint with different electricity mixes during charging



An additional projection is also run using the National Renewable Energy Laboratory (NREL) Cambium model[11] using the most conservative scenario (95% grid decarbonization by 2050). This model includes the effects of the Inflation Reduction Act, which is expected to significantly reduce the carbon intensity of the United States electricity grid. The most conservative Cambium model is included as an independent alternative to the stated policy IEA projection and shows a lower carbon footprint, which gives confidence that the Rivian methodology is not overestimating grid improvements during the life of the EDV.

Service includes GHG emissions from scheduled service activities, such as tire and fluid replacements. Scheduled maintenance activities are included based on estimates from our engineering and service teams. Table 4 summarizes the carbon footprint from operation and service activities.

Table 4
Carbon footprint of operation and service

Activity	Carbon Footprint (g CO_2e/mi)	
	EDV 500	EDV 700
Operation	236	250
Service	23	23
Total	**259**	**274**

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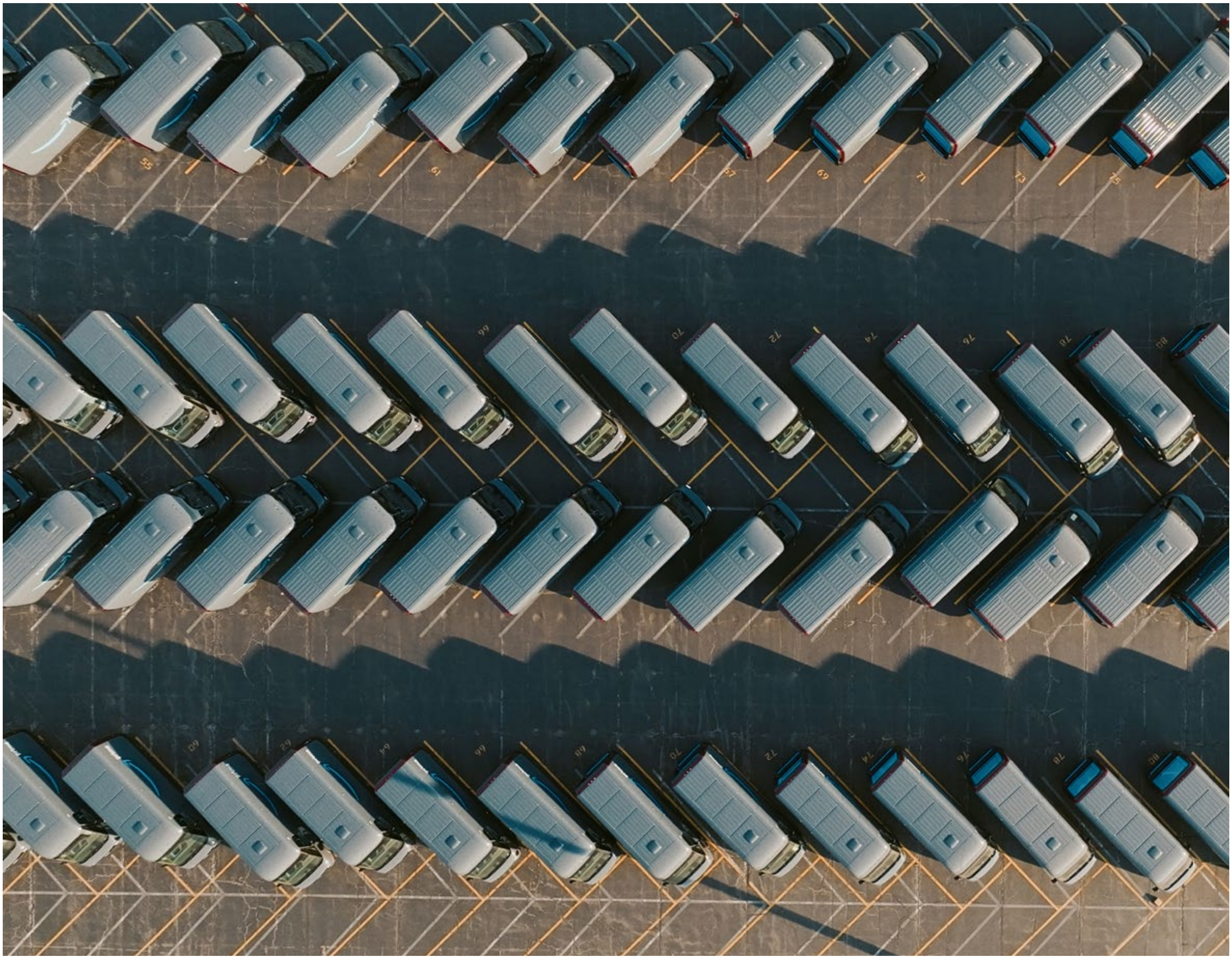
[10] The MROE eGRID subregion covers parts of Wisconsin and Michigan. More information about eGRID subregions can be found on the EPA website (https://www.epa.gov/eGRID/power-profiler#/)

[11] Gagnon, Pieter, Brady Cowiestoll, and Marty Schwarz. 2023. Cambium 2022 Scenario Descriptions and Documentation. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A40-84916. https://www.nrel.gov/docs/fy23osti/84916.pdf.



2.2 Decommissioning

Rivian vehicles have not yet been decommissioned under normal operating conditions, so we must make assumptions about the fate of the vehicles and their materials. Rivian has engaged battery recycling companies. As such, our batteries are expected to be recycled when the vehicle is decommissioned. We also assume that wheels and tires are removed from the vehicle prior to vehicle shredding and sent to recycling facilities. Under the cut-off allocation approach, the burden from recycling batteries and other materials is not included in the EDV carbon footprints. All other parts of the vehicle are assumed to go through a shredding operation where most of the steel and aluminum are captured for recycling, per industry averages. Most other materials, including mixed and unassigned, are assumed to be classified as automotive shredder residue (ASR) and landfilled. Overall, decommissioning contributes less than 1% of both EDV total carbon footprints.

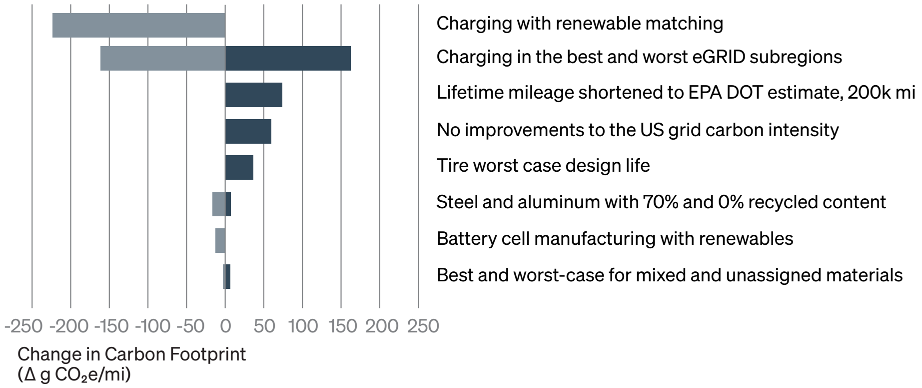
Scenario Analysis

We employ a multitude of estimations and assumptions throughout this study and strive to use conservative assumptions whenever possible to avoid underestimating potential impacts. To address some of the uncertainties and alternative use-case scenarios, the results of this study are supplemented with some of the most impactful findings from our scenario analyses.

Scenario Analysis

Figure 4 shows that procurement of renewable electricity to cover use phase energy consumption is one of the most effective decarbonization levers. The first scenario in Figure 4 shows that renewable matching across 330,000 miles decreases the carbon footprint by more than 220 g CO_2e/mi for each EDV (approximately 60%).

Figure 4
EDV 500 carbon footprint scenario analyses



While charging with renewable energy substantially decreases the carbon footprint of the EDV, we cannot fully decarbonize the vehicle with this lever alone—we must also continue to increase energy efficiency and decarbonize the materials that we use. Figure 4 also presents scenario analyses on various amounts of recycled content in the steel and aluminum in the EDV. This scenario demonstrates the potential change in the EDV carbon footprint if the recycled content of steel and aluminum is 0% or 70%. The analysis shows that introducing more recycled content in our material feedstocks is a potentially significant decarbonization lever. The scenario assessment of 70% recycled content in the aluminum alone lowers the entire carbon footprint of both baseline EDVs by over 3%. And for EDVs already charged with renewables, this scenario lowers the carbon footprints by over 8%.

While charging with renewable energy substantially decreases the carbon footprint of the EDV, we cannot fully decarbonize the vehicle with this lever alone—we must also continue to increase energy efficiency and decarbonize the materials that we use.

Final Thoughts

This report presents the life cycle carbon footprints of the Rivian EDV 500 and EDV 700 as assessed in mid 2023. The EDVs are designed to operate a decade into the future, so the results of this study are merely snapshots of the predicted product carbon footprints based on our best data available today.

Final Thoughts

We began conducting the EDV carbon footprints before the first vehicle was delivered. We did this because Rivian believes that, while our vehicles are critical in helping to decarbonize the transportation sector, electrification simply is not enough. This report and the supporting data and models allow us to create a strategy that builds on our strengths and mitigates areas of improvement.

We began conducting the EDV carbon footprints before the first vehicle was delivered. We did this because Rivian believes that, while our vehicles are critical in helping to decarbonize the transportation sector, electrification simply is not enough.

Below are some of the early takeaways from our first EDV carbon footprints. These points are driven by the data that we generated through our LCA and help us focus on the things that matter most.

- Improving propulsion efficiency addresses one of the largest parts of the EDV carbon footprint. We believe improved software, Rivian-designed drive units, and other solutions will help reduce these emissions.
- Renewable energy and other grid-related choices are key to decarbonization. Rivian and the users of our vehicles have an opportunity to dramatically reduce the carbon footprint from transportation by continuing to seek electricity with few or no GHG emissions.
- Decarbonizing materials is a priority for Rivian. Nearly 30% of the EDV carbon footprint occurs before the vehicle is assembled.
- Reducing the onsite production energy per vehicle is a key opportunity. As Rivian exits ramp and moves towards steady-state operations, we expect onsite production to become more efficient per vehicle.

Lastly, it is important to acknowledge that carbon footprints are models that reflect the best information that we have today. We will continue improving our understanding of our vehicle footprints and will share updates as that information improves. We view our carbon footprints as we do everything else at Rivian: Adventurous Forever.

Critical Review

This report was reviewed for conformance with ISO 14044 in combination with the underlying *Methodology Report* and Supporting Information by Dr. Christoph Koffler, Technical Director Americas, Sustainability Consulting at Sphera in November of 2023.

Appendix

6.1 Carbon Factors

Table 6.1a outlines the carbon factor datasets and categorizations for the material types in the refined BoM. The following data are used to find the carbon footprint of the materials and upstream manufacturing processes excluding battery cells. All data from the Sphera Managed LCA Content (MLC) database are from the Sphera LCA for Experts software version 10.7. A variety of plans were created in Sphera FE to support the modeling. These are marked with a <LC> term in Table 1, per Sphera nomenclature. The derivation of effective carbon intensity is shown below. The following table outlines the material types from the latest BoM from our product lifecycle management (PLM) system at the time of assessment (May-11-2023). We assume an average part yield of 95%.

$$CI_{\text{weighted average}} = [\%\ RC \times CI_{\text{recylced materials}} + (1\text{-}\%RC) \times CI_{\text{virgin materials}}]$$

$$CI_{\text{effective}} = \frac{[CI_{\text{weightedaverage}} /\ \%\ MU) + CI_{\text{manufacturing process}}\ ]}{\%Y}$$

CI= Carbon Intensity
RC= Percent Recycled Content
% MU= Percent Material Utilization
% Y= Percent Yield

Table 6.1a
Material Carbon Factor Datasets

Material Type	**Material Category**	**Dataset** IPCC AR6 GWP 100, excl biogenic CO_2, incl LUC (version Aug. 2021)
ABS	Polymers	DE: Acrylonitrile-butadiene-styrene granulate (ABS) mix Sphera
Adhesive	Polymers	DE: Thermoplastic polyurethane (TPU, TPE-U) adhesive Sphera
Aluminum	Aluminum	RNA: Aluminum sheet (0% recycled content) <LC>, RNA: Aluminum sheet (100% recycled content) <LC>
Aluminum (other)	Aluminum	RNA: Aluminum sheet (0% recycled content) <LC>, RNA: Aluminum sheet (100% recycled content) <LC>
Aluminum + glass	Mixed materials	Average of sheet aluminum and glass
Aluminum + plastic	Mixed materials	Average of sheet aluminum and plastic
Aluminum + steel	Mixed materials	Average of cold-rolled steel and sheet aluminum
Aluminum casting	Aluminum	RNA: Aluminum ingot (0% recycled content + remelting) <LC>, RNA: Aluminum ingot (100% recycled content + remelting) <LC>
Aluminum extrusion	Aluminum	RNA: Aluminum ingot (0% recycled content + remelting) <LC>, RNA: Aluminum ingot (100% recycled content + remelting) <LC>
Aluminum forging	Aluminum	RNA: Aluminum ingot (0% recycled content + remelting) <LC>, RNA: Aluminum ingot (0% recycled content + remelting) <LC>
Aluminum sheet	Aluminum	RNA: Aluminum sheet (0% recycled content) <LC>, RNA: Aluminum sheet (100% recycled content) <LC>
ASA	Polymers	DE: Acrylonitrile-butadiene-styrene granulate (ABS) mix Sphera
Assembly	Mixed materials	Vehicle specific average
Brass	Other metals	RER: Brass (CuZn20) Sphera <p-agg>
Brass + plastic	Mixed materials	Average of brass and plastic
Cobalt sulfate	Other materials	GLO: Cobalt sulphate heptahydrate (CoSO4 7H2O) CI
Cold-rolled steel sheet	Steel	GLO: Cold-rolled steel coil (HDG, 0% recycled content) <LC>,
Composite	Polymers	Carbon Fiber-reinforced plastic product for general use (GREET)
Copper	Other metals	GLO: Copper (99.99%; cathode) ICA
Copper + plastic	Mixed materials	Average of copper and plastic
ECU	Electronics	Vehicle specific average
EPDM	Polymers	DE: Ethylene propylene diene elastomer (EPDM) Sphera
EPP foam	Polymers	US: Expanded polypropylene (EPP) <LC>
Fiberglass	Other materials	US: Fiberglass pipe NAIMA
Glass	Other materials	RER: Float flat glass Sphera
Glass + plastic	Mixed materials	Average of glass and plastic

Material Type	Material Category	Dataset IPCC AR6 GWP 100, excl biogenic CO_2, incl LUC (version Aug. 2021)
HDPE	Polymers	DE: Polyethylene high density granulate (HDPE/PE-HD) mix Sphera
Hot-rolled steel sheet	Steel	GLO: Hot-rolled steel coil (HDG, 0% recycled content) <LC>,
Iron	Other metals	DE: Cast iron component (EN15804 A1-A3) Sphera <p-agg>
Liquid	Other materials	DE: Rinsing-agent (100% solvents) Sphera
Magnesium	Other metals	CN: Magnesium Sphera
Magnet	Other materials	GLO: market for permanent magnet, for electric motor ecoinvent 3.8
Mica	Other materials	DE: Kaolin Sphera
Mixed	Mixed materials	Vehicle specific average
Nickel sulfate	Other materials	GLO: Nickel sulphate hexahydrate (NiSO4 6H2O) Nickel Institute
Other foam	Polymers	RER: Polyurethane rigid foam (PU) PlasticsEurope
PA	Polymers	DE: Polyamide 6 granulate (PA 6) mix Sphera
Paint	Other materials	RER: Solvent paint white (EN15804 A1-A3) Sphera
Paper	Other materials	EU-25: Graphic paper euro-graph/ELCD <LC>
PBT	Polymers	DE: Polybutylene terephthalate granulate (PBT) mix Sphera
PC	Polymers	DE: Polycarbonate granulate (PC) Sphera
PC/ABS	Polymers	Average of PC and ABS
PC/ASA	Polymers	Average of PC and ASA
PCB (2-layer rigid FR4)	Electronics	GLO: Printed wiring board 2-layer rigid FR4 with chem-elec AuNi finish (subtractive method) Sphera
PCB (4-layer rigid FR4)	Electronics	GLO: Printed wiring board 4-layer rigid FR4 with chem-elec AuNi finish (subtractive method) Sphera
PCB (8-layer rigid FR4)	Electronics	GLO: Printed wiring board 8-layer rigid FR4 with chem-elec AuNi finish (subtractive method) Sphera
PCB (10-layer rigid FR4)	Electronics	GLO: Printed wiring board 10-layer rigid FR4 with chem-elec AuNi finish (subtractive method) Sphera
PCB (12-layer rigid FR4)	Electronics	GLO: Printed wiring board 12-layer rigid FR4 with chem-elec AuNi finish (subtractive method) Sphera
PCB (16-layer rigid FR4)	Electronics	GLO: Printed wiring board 16-layer rigid FR4 with chem-elec AuNi finish (subtractive method) Sphera
PET	Polymers	DE: Polyethylene terephthalate granulate (PET via DMT) Sphera
Plastic	Polymers	Rivian average
PMMA	Polymers	DE: Polymethyl methacrylate granulate (PMMA) mix Sphera
POM	Polymers	DE: Polyoxymethylene granulate (POM) Mix Sphera
PP	Polymers	DE: Polypropylene granulate (PP) mix Sphera
PPO	Polymers	DE: Polyphenylene ether (PPE) Sphera
PPS	Polymers	DE: Polyphenylene sulfide granulate (PPS) Sphera
Press hardened steel sheet	Steel	GLO: Cold-rolled steel coil (HDG, 0% recycled content) <LC>,
PU	Polymers	DE: PUR synthetic leather seat cover (1 kg) Sphera <LC>
PUR foam	Polymers	RER: Polyurethane rigid foam (PU) PlasticsEurope
PVC	Polymers	DE: Polyvinyl chloride granulate (S-PVC) mix Sphera
Rubber	Polymers	DE: Silicone rubber (RTV-2, condensation) Sphera
Silicone	Polymers	DE: Silicone rubber (RTV-2, condensation) Sphera
Stainless steel	Steel	RER: Stainless steel cold-rolled coil (316) Eurofer <LC>
Stainless steel + plastic	Mixed materials	Average of stainless steel and plastic
Steel	Steel	GLO: Cold-rolled steel coil (HDG, 0% recycled content) <LC>,
Steel (other)	Steel	GLO: Cold-rolled steel coil (HDG, 0% recycled content) <LC>,
Steel + aluminum	Mixed materials	Average of cold-rolled steel and sheet aluminum
Steel + plastic	Mixed materials	Average of cold-rolled steel and plastic
Tire	Other materials	Vendor data (Pirelli)
TPE	Polymers	DE: Polypropylene / ethylene propylene diene elastomer granulate (PP/EPDM, TPO, TPE-O) mix Sphera
TPO	Polymers	DE: Polypropylene / ethylene propylene diene elastomer granulate (PP/EPDM, TPO, TPE-O) mix Sphera
TPV	Polymers	DE: Polypropylene / ethylene propylene diene elastomer granulate (PP/EPDM, TPO, TPE-O) mix Sphera
Unassigned	Unknown	Vehicle specific average
Unknown	Unknown	Vehicle specific average
Washer fluid	Other materials	US: Washer fluid (21% ethyl alcohol / 79% deionized water) (plan) <LC>
Wood	Other materials	RNA: Softwood plywood CORRIM <LC>
Zinc	Other metals	GLO: Special high grade zinc only from Zn concentrate IZA <LC>

Table 6.1b outlines the default assumptions and carbon factor datasets for the activities excluding raw material mining and refining. The following data are critical to assessing the carbon footprint of upstream production processes, on-site production, operation and service, and decommissioning.

Material utilizations are planned scrap losses that occur during manufacturing. These are often very difficult to ascertain, particularly when these steps occur in the supply chain. We use a mix of internal data, industry averages and estimates for material utilizations. In-house stamping utilizations are based on early Rivian data for EDVs. Casting, drawing, and injection molding processes are typically high-utilization processes and are assumed to have 95% utilization. Aluminum extrusion is based on the Aluminum Association data and is 74%. All other processes, including those for mixed and unassigned materials, are assumed to have a 75% utilization. In addition to utilizations, we also include a 95% yield to all parts. This is an assumed value and is used to acknowledge that a certain fraction of all parts will not meet specifications or otherwise are unavailable for the final vehicle.

Table 6.1b
Carbon Factor Datasets: Processes, Transportation, Energy, and Decommissioning

Manufacturing Processes	Material Category	Dataset	Default Material Utilization
Injection molding	-	US: Plastic injection moulding process Sphera (plan) <LC>	95%
Metal sheet deep drawing	-	US: Steel sheet deep drawing <LC>	*material specific*
Aluminum die casting	-	US: Aluminium die-cast part Sphera 5% scrap (plan) <LC>	95%
Aluminum extrusion	-	RER: Aluminium extrusion profile - open input aluminium ingot Sphera <p-agg>	74%
Aluminum forging	-	US: Drop-forging process Sphera (plan) <LC>	75%
Metal casting	-	US: Metal cast part (automotive) process Sphera (plan) <LC>	95%
Wire forming	-	US: Copper wire (0.6 mm) process Sphera (plan) <LC>	95%
Magnesium die casting	-	US: Magnesium die-cast process Sphera (plan) <LC>	95%

Decommissioning Processes	Material Category	Dataset	Default Material Utilization
Landfill	Aluminum	RER: Inert matter (Aluminium) on landfill Sphera	-
Landfill	Steel	RER: Inert matter (Steel) on landfill Sphera	-
Landfill	Polymers	RER: Plastic waste on landfill Sphera	-
Landfill	Mixed materials	Calculated - based on polymers	-
Landfill	Other metals	Calculated - based on steel	-
Landfill	Other materials	Calculated - based on polymers	-
Landfill	Electronics	Calculated - based on polymers	-
Landfill	Unknown	Calculated - based on polymers	-
Incineration	Aluminum	US: Inert waste in waste incineration plant Sphera (plan) <LC>	-
Incineration	Steel	US: Inert waste in waste incineration plant Sphera (plan) <LC>	-
Incineration	Polymers	US: Plastic packaging in municipal waste incineration plant Sphera <p-agg> <LC>	-
Incineration	Mixed materials	Calculated - based on polymers	-
Incineration	Other metals	Calculated - based on steel	-
Incineration	Other materials	Calculated - based on polymers	-
Incineration	Electronics	US: Populated printed wiring board (after RoHS) in waste incineration plant Sphera <p-agg> <LC>	-
Incineration	Unknown	Calculated - based on polymers	-
Vehicle shredding	-	DE: Car shredder Sphera <p-agg>	-

Transportation Process	Material Category	Dataset	Default Material Utilization
Air	-	GLO: Cargo plane Sphera (plan) <LC>	-
Rail	-	US: Rail transport cargo - average, average train, gross tonne weight 1,000t / 726t payload capacity <LC>	-
Autocarrier	-	US: Truck - auto carrier (EPA SmartWay) Sphera (plan) <LC>	-
TL	-	US: Truck - TL/dry van (EPA SmartWay) Sphera (plan) <LC>	-
LTL	-	US: Truck - LTL/dry van (EPA SmartWay) Sphera (plan) <LC>	-
Cartage	-	US: Truck - LTL/dry van (EPA SmartWay) Sphera (plan) <LC>	-
Drayage	-	US: Truck - dray (EPA SmartWay) Sphera (plan) <LC>	-
FCL	-	GLO: Transoceanic ship, containers, 27,500 dwt payload capacity, ocean going Sphera (plan) <LC>	-
LCL	-	GLO: Transoceanic ship, containers, 27,500 dwt payload capacity, ocean going Sphera (plan) <LC>	-
Ocean	-	US: Average ship, 3,500t payload capacity / upstream Sphera (plan) <LC>	-
Parcel[12]	-	Calculated average of cargo plane and LTL/dry van	-

Energy	Material Category	Dataset	Default Material Utilization
AKGD	-	US: Electricity grid mix – AKGD Sphera	-
AKMS	-	US: Electricity grid mix – AKMS Sphera	-
AZNM	-	US: Electricity grid mix – AZNM Sphera	-
CAMX	-	US: Electricity grid mix – CAMX Sphera	-
ERCT	-	US: Electricity grid mix – ERCT Sphera	-
FRCC	-	US: Electricity grid mix – FRCC Sphera	-
HIMS	-	US: Electricity grid mix – HIMS Sphera	-
HIOA	-	US: Electricity grid mix – HIOA Sphera	-
MROE	-	US: Electricity grid mix – MROE Sphera	-
MROW	-	US: Electricity grid mix – MROW Sphera	-
NEWE	-	US: Electricity grid mix – NEWE Sphera	-
NWPP	-	US: Electricity grid mix – NWPP Sphera	-
NYCW	-	US: Electricity grid mix – NYCW Sphera	-
NYLI	-	US: Electricity grid mix – NYLI Sphera	-
NYUP	-	US: Electricity grid mix – NYUP Sphera	-
NYST	-	Calculated mix of NYLI, NYCW, NYUP	-
RFCE	-	US: Electricity grid mix – RFCE Sphera	-
RFCM	-	US: Electricity grid mix – RFCM Sphera	-
RFCW	-	US: Electricity grid mix – RFCW Sphera	-
RMPA	-	US: Electricity grid mix – RMPA Sphera	-
SPNO	-	US: Electricity grid mix – SPNO Sphera	-
SPSO	-	US: Electricity grid mix – SPSO Sphera	-
SRMV	-	US: Electricity grid mix – SRMV Sphera	-
SRMW	-	US: Electricity grid mix – SRMW Sphera	-
SRSO	-	US: Electricity grid mix – SRSO Sphera	-
SRTV	-	US: Electricity grid mix – SRTV Sphera	-
SRVC	-	US: Electricity grid mix – SRVC Sphera	-
Alaska	-	US: Electricity grid mix (Alaska) Sphera	-
Hawaii	-	US: Electricity grid mix (Hawaii) Sphera	-
Texas	-	US: Electricity grid mix (Texas) Sphera	-
Canada	-	CA: Electricity grid mix Sphera	-
Eastern US	-	US: Electricity grid mix (East) Sphera	-

[12] Parcel is a 50:50 split between cargo plane and LTL transportation.

Energy	Material Category	Dataset	Default Material Utilization
Western US	-	US: Electricity grid mix (West) Sphera	-
US eGRID Average	-	US: Electricity grid mix (eGRID) Sphera	-
US Average	-	US: Electricity grid mix Sphera	-
US Wind	-	US: Electricity from wind power Sphera	-
US Solar	-	US: Electricity from photovoltaic Sphera	-
US Coal	-	US: Electricity from hard coal Sphera	-
US Natural Gas	-	US: Electricity from natural gas Sphera	-
US Hydro	-	US: Electricity from hydro power Sphera	-
US Nuclear	-	US: Electricity from nuclear Sphera	-
US Geothermal	-	US: Electricity from geothermal Sphera	-
Argentina	-	AR: Electricity grid mix Sphera	-
Australia	-	AU: Electricity grid mix Sphera	-
Chile	-	CL: Electricity grid mix Sphera	-
China	-	CN: Electricity grid mix Sphera	-
Hungary	-	HU: Electricity grid mix Sphera	-
Japan	-	JP: Electricity grid mix Sphera	-
Korea	-	KR: Electricity grid mix Sphera	-
Malaysia	-	MY: Electricity grid mix Sphera	-
Portugal	-	PT: Electricity grid mix Sphera	-
Europe 2020	-	RER: Electricity grid mix (2020) Sphera	-
US Generic Renewables	-	US: Green electricity grid mix (production mix) Sphera	-

Other Energy Sources	Material Category	Dataset	Default Material Utilization
Diesel	-	US: Diesel mix at refinery Sphera	-
Premium gasoline	-	US: Gasoline mix (premium) at refinery Sphera	-
Regular gasoline	-	US: Gasoline mix (regular) at refinery Sphera	-
Liquefied petroleum gas	-	US: Liquefied petroleum gas (LPG) (70% propane; 30% butane) Sphera	-
Heavy fuel oil (0.3 wt. %)	-	US: Heavy fuel oil at refinery (0.3wt.% S) Sphera	-
Heavy fuel oil (2.5 wt. %)	-	US: Heavy fuel oil at refinery (2.5wt.% S) Sphera	-
Light fuel oil	-	US: Light fuel oil at refinery Sphera	-
Propane	-	US: Propane at refinery Sphera	-

6.1.1 Aluminum

Rivian developed carbon footprint models for aluminum ingot and sheet. The models are based on the Aluminum Association LCA report for semi-fabricated products[13]. Rather than use the information directly from the report or the analogous datasets in the Sphera MLC, Rivian reconstructed these models so that recycled content could be a variable. Any level of recycled content can be evaluated through interpolation between these models. Utilizations and processing steps mirror the information in the Aluminum Association report and use automotive-specific information whenever available.

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[13] The Environmental Footprint of Semi-Fabricated Aluminum Products in North America. The Aluminum Association. 2022. https://www.aluminum.org/sites/default/files/2022-01/2022_Semi-Fab_LCA_Report.pdf

6.1.2 Steel

Rivian developed carbon footprint models for hot and cold-rolled sheet with varying levels of recycled content. Worldsteel data[14] for steel sheet assumes a scrap input based on industry averages. By adding the "value of scrap" dataset upstream, the scrap inputs are assigned the burden of primary steel, thus approximating a theoretical steel sheet with 0% recycled content. These models are combined with the standard worldsteel datasets in Sphera so that any level of recycled content can be evaluated through interpolation and extrapolation.All steel is assumed to be hot-dip galvanized. The hot-dip galvanizing model was developed using data from the American Iron and Steel Institute (AISI)[15].

6.1.3 Electronic Control Units

Much of the advanced electronics are housed in electronic control unit (ECU) modules. The GHG emissions of ECUs can vary significantly depending on the size and complexity of the printed circuit board (PCB), onboard electronics, and the housing materials. To better understand the carbon footprint of the low-voltage electronics in our vehicles, Rivian conducted an internal study to determine the carbon footprint of all the ECUs in Rivian vehicles. From this, we derived average carbon intensity factors for our ECUs that will be used across all Rivian vehicles until another study is conducted.

The subcomponents of an ECU can be broken down into two categories: populated PCBs and mechanical parts. The mechanical parts are made up of polymers and metals. As such, the corresponding carbon factors from the datasets shown in Table 6.1a scale by mass, which allows us to use the ECU BoM to find the carbon footprint of the mechanical parts.

The GHG emissions for an unpopulated PCB are determined by exploring engineering drawings to determine the rectangular dimensions and number of layers of the PCB. Using rectangular dimensions rather than actual area allows us to approximate losses associated with panelization efficiency during PCB fabrication. This data are then combined with carbon intensity factors for the appropriate type of PCB.

Determining the GHG emissions of the onboard electronics (integrated circuits, resistors, capacitors, etc.) is more difficult and has not been researched in detail. For our early models, we estimate that a populated PCB will have approximately double the carbon footprint of an unpopulated PCB based on examination of generic populated PCB data from Sphera's MLC database. While this estimation is relatively rough, the populated ECUs contribute less than 1% to the life cycle carbon footprint of an EDV. As such, the uncertainty introduced into the overall results is acceptable for the goal of this study.

6.1.4 Other Plans

A variety of other plans were created in Sphera FE to support the modeling. These are marked with an <LC> term in Table 6.1a, per Sphera nomenclature. Many plans are simple scaling functions used to normalize a process to a declared unit of 1 kg. Other plans are processes with upstream energy and operating materials (e.g., lubricants) flows connected using US data (e.g., US average electricity, US thermal energy from natural gas). These types of simple plans reflect the data in unit processes from Sphera's MLC database and are not published here.

For example, the plans for expanded polypropylene (EPP) and plastic injection are slightly more complex and cannot be found directly in Sphera's MLC database. For EPP, no data on this material are available, so an estimate was made using PP granulate and an extrusion unit process. This is a crude estimate, but not expected to have relevant impact on the results.

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[14] Life Cycle Inventory (LCI) Study: 2020 Data Release. World Steel Association. 2021.

[15] Life Cycle Inventories of North American Steel Products. American Iron and Steel Institute. 2020.

6.2 Onsite Production

The carbon footprint from onsite production is calculated using site specific data from the Rivian production plant in Normal, IL in Q1 of 2023. The footprint from the production at Normal is divided evenly across the number of saleable vehicles in Q1 of 2023. The Normal production plant lies in the eGRID subregion SRMW; the 2020 eGRID data from Sphera's MLC database are used as the carbon intensity for all electricity pulled from the grid. The 2020 fuel mix of this subregion is as follows[16]:

- 15% Natural Gas
- 62% Coal
- 16% Nuclear
- 7% Hydro, Wind, or Solar
- <1% Other Fossil Fuels

The production plant in Normal, IL, is equipped with an array of rooftop solar panels. At the plant, neither the solar energy nor any renewable energy credits are sold back to the grid (or any other third party). The energy is rather used exclusively by Rivian onsite. The upstream GHG emissions from the solar energy are less than 1 kg CO_2e / vehicle.

6.3 Logistics

The carbon footprint of inbound logistics is based on the cargo and freight transport that pertains to vehicle production at the Rivian production plant in Normal, IL. Carbon factors from Sphera's MLC database (as shown in Table 6.1b) are used when freight mass and distance data are reported in the TMS system. In the absence of mass inputs, cost data are used alongside CEDA factors from CEDA Global 4.01 to determine the GHG emissions from these parts. Comparing the mass and cost data for parts with both metrics available, we find the cost-based estimation consistently more conservative.

The carbon footprint from all incoming freight that consists of materials and parts related to vehicle production is divided across the number of saleable Rivian vehicles produced in Q1 of 2023 to yield the average carbon footprint of inbound logistics per vehicle.

The carbon footprint of outbound logistics is found using the mode and distance of transportation for all vehicle sales in Q1 2023. This data are divided across the number of saleable Rivian vehicles produced in Q1 2023 to yield the average carbon footprint of outbound logistics per vehicle. The carbon footprint of this is found using the carbon factors outlined in Table 6.1b.

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[16] https://www.epa.gov/system/files/documents/2022-01/egrid2020_summary_tables.pdf

6.4 Charging

We allocate EDV sales data to the respective eGRID subregions using the zip codes that correspond to the sale and the Power Profiler tool from the EPA[17]. We assume each vehicle is driven in the subregion in which it was originally purchased. For a small number of EDV sales, the zip code could either not be determined or was outside of an eGRID subregion; these sales were allocated to US average.

Each grid factor from 2020 is from Sphera's MLC database with datasets listed in Table 6.1b. All following years are projected using a 3% year-over-year improvement that is slightly more pessimistic than the most conservative IEA projections[18]. To determine if the national 3% year-over-year improvement was suitable at the eGRID subregions, we compared our projection with the Mid-Case Annual GEA scenario published in the latest version of the NREL Cambium model[19]. The IEA projections and Cambium Mid-Case Annual GEA scenario are plotted with Rivian's 3% year-over-year model in Figure 6.4a.

Figure 6.4a
IEA "stated policies" projection plotted with Rivian 3% year-over-year US average grid improvements and Cambium conservative scenario

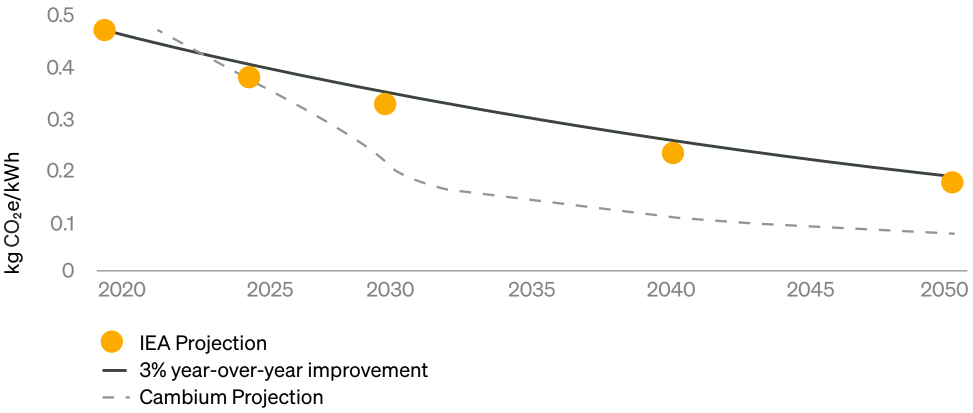
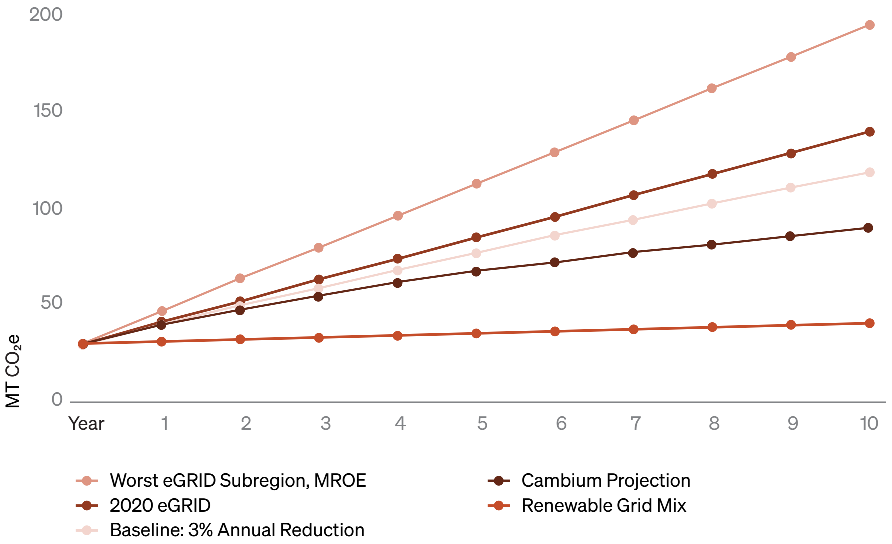


Figure 6.4b
EDV 700 cumulative carbon footprint with different electricity mixes during charging



[17] https://www.epa.gov/egrid/power-profiler#/

[18] https://iea.blob.core.windows.net/assets/4ed140c1-c3f3-4fd9-acae-789a4e14a23c/WorldEnergyOutlook2021.pdf

[19] https://www.nrel.gov/analysis/cambium.html

6.5 Decommissioning

The carbon footprint of the decommissioning of the materials in a Rivian EDV is estimated using the rates of decommissioning scenarios shown in Table 6.5a. Materials that are not expected to be isolated during decommissioning processing are modeled as automotive shredder residue (ASR) and assumed to be landfilled.

Table 6.5a
Decommissioning Fate by Material Category

Material Category	% Recycled	% Landfilled	% Incinerated	Source
Aluminum	91%	9%	0%	Kelly S., Apelian D.
Steel	96%	4%	0%	American Iron and Steel Institute
Polymers	0%	100%	0%	Assumption
Mixed materials	0%	100%	0%	Modeled as ASR
Other metals	96%	4%	0%	Modeled as steel
Other materials	0%	100%	0%	Modeled as ASR
Electronics	90%	5%	5%	Assumption
Unknown	0%	100%	0%	Modeled as ASR
Tires	100%	0%	0%	Assumption
Battery cells	100%	0%	0%	Assumption

Table 6.5b shows the carbon footprint for decommissioning, which is primarily from landfilling and vehicle shredding processes. Overall, decommissioning contributes less than 1% of both EDV total carbon footprints.

Table 6.5b
Carbon footprint of decommissioning

Activity	Carbon Footprint (g CO_2e/mi)	
	EDV 500	EDV 700
Shredding	0.2	0.2
Recycling	-	-
Landfilling	0.2	0.2
Incineration	<0.1	<0.1
Total	**0.3**	**0.4**

6.6 Detailed Footprint Summary

Figure 6.6a shows the mass and carbon footprint breakdown by material category of the EDV 700.

Figure 6.6a
EDV 700 mass and carbon footprint breakdown by material category

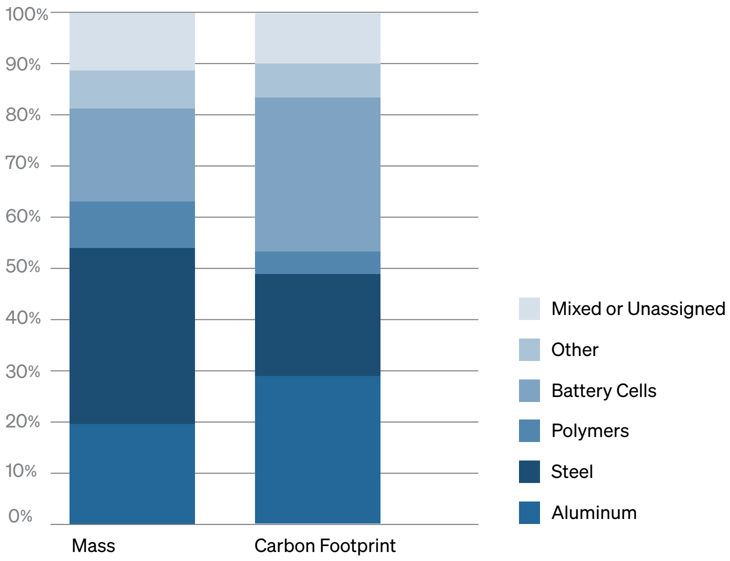


Figure 6.6b shows the scenario analysis for EDV 700.

Figure 6.6b
EDV 700 carbon footprint scenario analyses

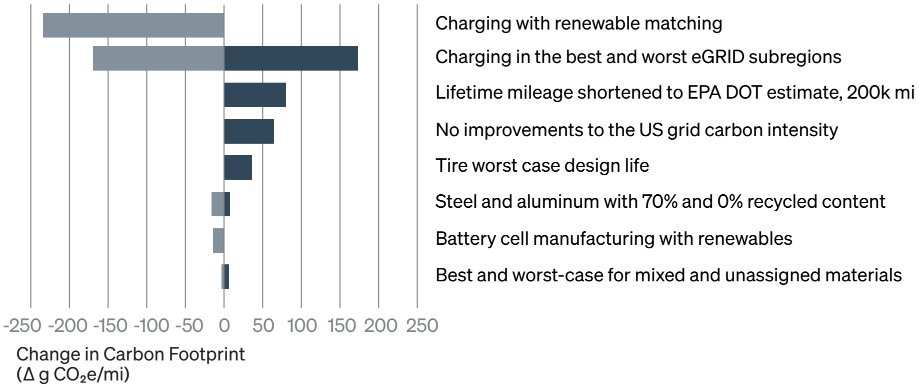


Table 6.6c and Table 6.6d show the detailed carbon footprint for the EDV 700 and EDV 500 in MT CO_2e.

Table 6.6c
Detailed carbon footprint for the EDV 500 (MT CO_2e)

		Body system	Chassis system	Interior system	Powertrain system	Other systems	Battery cells	Logistics	Onsite production	Charging	Maintenance	Decommissioning
Materials and upstream production	Aluminum	5.3	0.7	0.0	0.2	1.6						
	Steel	3.8	1.0	0.3	0.2	0.2						
	Polymers	0.5	0.1	0.3	0.0	0.3						
	Mixed materials	0.5	0.1	0.3	0.1	0.3						
	Other metals	1.2	0.1	0.0	0.0	0.1						
	Other materials	0.1	0.4	0.0	0.0	0.1						
	Electronics	0.0	0.0	0.0	0.0	0.4						
	Unknown	0.8	0.1	0.3	0.0	0.2						
	Battery cells						8.3					
Logistics	Upstream							2.0				
	Downstream							0.3				
Onsite production	Scope 1 and 2								3.9			
	Scope 3								0.5			
Operation and maintenance	Charging									77.8		
	Expected maintenance										7.7	
Decommissioning	Shredding											0.1
	Landfill											0.1
	Incineration											0.0
Total		**12.1**	**2.5**	**1.2**	**0.5**	**3.2**	**8.3**	**2.3**	**4.5**	**77.8**	**7.7**	**0.1**

Table 6.6d
Detailed carbon footprint for the EDV 700 (MT CO_2e)

		Body system	Chassis system	Interior system	Powertrain system	Other systems	Battery cells	Logistics	Onsite production	Charging	Maintenance	Decommissioning
Materials and upstream production	Aluminum	6.6	0.7	0.0	0.2	1.6						
	Steel	3.7	1.1	0.3	0.2	0.2						
	Polymers	0.5	0.1	0.4	0.0	0.3						
	Mixed materials	0.5	0.2	0.3	0.1	0.3						
	Other metals	2.0	0.1	0.0	0.0	0.0						
	Other materials	0.1	0.4	0.0	0.0	0.1						
	Electronics	0.0	0.0	0.0	0.0	0.4						
	Unknown	0.8	0.1	0.3	0.0	0.5						
	Battery cells						8.3					
Logistics	Upstream							2.0				
	Downstream							0.3				
Onsite production	Scope 1 and 2								3.9			
	Scope 3								0.5			
Operation and maintenance	Charging									82.6		
	Expected maintenance										7.7	
Decommissioning	Shredding											0.1
	Landfill											0.1
	Incineration											0.0
Total		**14.2**	**2.7**	**1.3**	**0.5**	**3.4**	**8.3**	**2.3**	**4.5**	**82.6**	**7.7**	**0.1**

- Critical Review Statement -

Electric Delivery Vehicle Carbon Footprint - Version 1.0

EDV Carbon Footprint Supporting Information (CONFIDENTIAL) – Version 1.0

Carbon Footprint Methodology Report – Version 1.0

Commissioned by:	Rivian Automotive, Inc. ("Rivian")
Conducted by:	Rivian Automotive, Inc. ("Rivian")
Reviewers:	Christoph Koffler, PhD – Technical Director Americas, Sustainability Consulting
References:	ISO 14044:2006 – Environmental Management – Life Cycle Assessment – Requirements and Guidelines ISO 14067:2018 Greenhouse gases – Carbon Footprint of Products – Requirements and Guidelines for Quantification ISO/TS 14071:2014 — Environmental management — Life cycle assessment — Critical review processes and reviewer competencies:Additional requirements and guidelines to ISO 14044:2006

Scope of the Critical Review

In accordance with ISO 14044:2006, section 6.1, the goal of the Critical Review was toassess whether:

- the methods used to carry out the LCA are consistent with the internationalstandards ISO 14040 and ISO 14044,
- the methods used to carry out the LCA are scientifically and technically valid,
- the data used are appropriate and reasonable in relation to the goal of the study,
- the interpretations reflect the limitations identified and the goal of the study, and
- the study report is transparent and consistent.

As the study is not intended to support comparative assertions intended to be disclosed to the public, the review was performed by single independent expert following ISO 14044:2006, section 6.2.

This review statement is only valid for the specific reports and version numbers listed in the header of this review statement.

The review was performed exclusively on the above documents. No software models were shared during the review.

The reviewer performed the review in his capacity as an independent expert.

Critical Review process

The review was conducted by exchanging comments and responses using a spreadsheet template based on Annex A of ISO/TS 14071:2014.

The critical review was carried out between May 2023 (submission of first draft reports) and November 2023 (delivery of the final review statement). There were multiple formal rounds of comments on different draft versions of the reports, online meetings to discuss and clarify those comments, as well as several email conversations in-between.

A copy of the final review report containing all written comments and responses has been provided to Rivian along with this review statement.

The overall review was conducted in an equitable and constructive manner. The reviewer would like to highlight the good and constructive collaboration with the authors of the study. All comments were addressed and all open issues resolved. There were no dissenting opinions held by any of the involved parties upon finalization of the review.

General evaluation

The study is well scoped and capable of supporting the goal of the study. It shows a high level of technical knowledge and methodological proficiency. It is based on a multitude of data sources and primary data points covering material composition, in-house manufacturing, and use phase parameters to achieve a high level of data quality.

Its main limitation lies in the complexity of the automotive supply chain and the limited availability of primary supplier data, which is a general issue in the automotive industry and not specific to this study. As such, the study should be understood to represent mostly market-average supply chain emissions based on conservative assumptions and best-available data. Nevertheless, the results are deemed to be sufficiently accurate for external communication as well as for internal use to identify opportunities for further improvement.

Conclusion

Based on the final report documents, it can be concluded that the methods used to carry out the LCA are consistent with the International Standard ISO 14044, that they are scientifically and technically valid, that the data used are appropriate and reasonable in relation to the goal of the study, and that the interpretations reflect the limitations identified and the goal of the study. The report documents are considered sufficiently transparent and consistent.

When communicating results to third parties outside of Rivian, ISO 14044, section 5.2 requires that a third-party report be made available to any such parties. For this specific study, the combination of Summary Report (including Appendix) and Methodology Report shall constitute the third-party report.
=

Christoph Koffler, PhD

Valid as of 11/21/2023