Battery Cost Projections – Midterm Report

This report has been prepared for



CONTRIBUTORS

Sawyer D. Stone, Noah Heck, Christopher Irwin

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Corresponding Author: sawyer.stone@roush.com

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Corresponding Author: sawyer.stone@roush.com

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Abbreviations and Acronyms

BEV	Battery Electric Vehicle
EV	Electric Vehicle
HDV	Heavy-Duty Vehicle
HEV	Hybrid Electric Vehicle
LDV	Light-Duty Vehicle
LFP	Lithium Ferro (Iron) Phosphate
LMR	Lithium Manganese Rich
MY	Model Year
NMC	Nickel Manganese Cobalt
PHEV	Plug-In Hybrid Electric Vehicle

1. Introduction

1.1 Background

The electric vehicle market in the United States has been an increased area of focus in recent years. As of February 2025, the percentage of new full electric vehicle sales in the United States market was 7.9%, up from 1.6% in 2020 [1]. A significant portion of the cost of an electric vehicle is due to the battery pack. Electric vehicle (EV) battery and vehicle costs are decreasing, and they are approaching purchase price parity with internal combustion engine (ICE) vehicles, which is expected to increase EV adoption and market share.

In 2022-2023, Environmental Defense Fund and Roush performed a number of studies examining the costs of electrification for EVs in the light-, medium-, and heavy-duty segments in the (then) present and through 2030. This report looks back at these prior projections and compares them to current battery costs. Additionally, the projections are compared with current projections for costs, and a second look is given to battery costs over the next 5 years.

2. Prior Projections

Roush and EDF have released 3 primary studies on the costs of electrification in 2022 and 2023: “Medium and Heavy-Duty Electrification Costs for MY 2027-2030,” “Electrification Cost Evaluation of Light-Duty Vehicles for MY 2030,” and “Alternative Powertrain Pathways for Light-Duty and Class 3 Vehicles for MYs 2024, 2027, and 2035 to Meet Future CO2 Emission Targets” [2], [3], [4] While these reports examined the cost of electrification for entire vehicles, a core component of the costing exercise focuses on the cost of batteries for powering EVs.

Batteries are a significant portion of the cost of an EV in both light- and heavy-duty vehicles, at times up to 30% of the vehicle cost. When discussing specific battery costs, these are often quantified as a cost per kilowatt-hour ($/kWh). This normalizes the cost to a measurable unit of energy that can be used for moving the car, and excludes factors such as material density, energy density, pack size, and chemistry differences. Costs provided are given as cost to the OEM for a battery pack.

2.1 Medium- and Heavy-Duty Electrification

This report examined the total cost of ownership of vehicles from Class 3 delivery vans to Class 8 transit buses for electrification. To determine initial purchase price, ICE-only and battery electric vehicle (BEV)-only components were costed and the ICE components removed from vehicle price and BEV components added to show the differential between the two vehicles. This study also identified heavy-duty (HD) EV batteries as a different construction than light-duty vehicle (LDV) batteries with a higher cost, something that has since converged.

To create the various costing sensitivities, scenarios were created where the vehicle used nickel-manganese-cobalt (NMC) batteries as the standard, and lithium ferrophosphate (LFP) batteries as a low-cost option, as they continue to be lower-cost and utilize less expensive metals in their construction.

The cost projections presented in this study are replicated in Figure 1, updated to 2025 dollars.

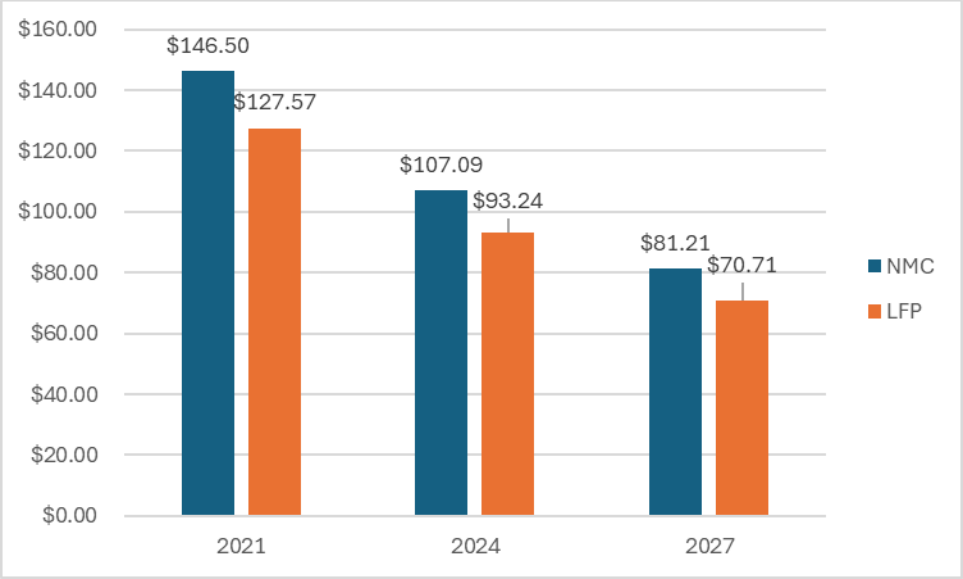


Figure 1: Battery Pack Costs from "Medium and Heavy-Duty Electrification Costs for MY 2027-2030" in 2025 Dollars

2.2 Light-Duty Electrification

The report "Electrification Cost Evaluation of Light-Duty Vehicles for MY 2030" issued in 2023, with projections summarized in Figure 2, examined similar scenarios to the MD-HD report, but using small and medium cars, small, midsize, and large SUVs, and pickup trucks as the subjects of the study. The same NMC vs LFP sensitivity was created, but based on the lower-cost LDV architecture in place at the time and available modeling techniques and tools such as BatPaC Battery Manufacturing Cost Estimation software modeling tool from Argonne National Laboratory. [5]

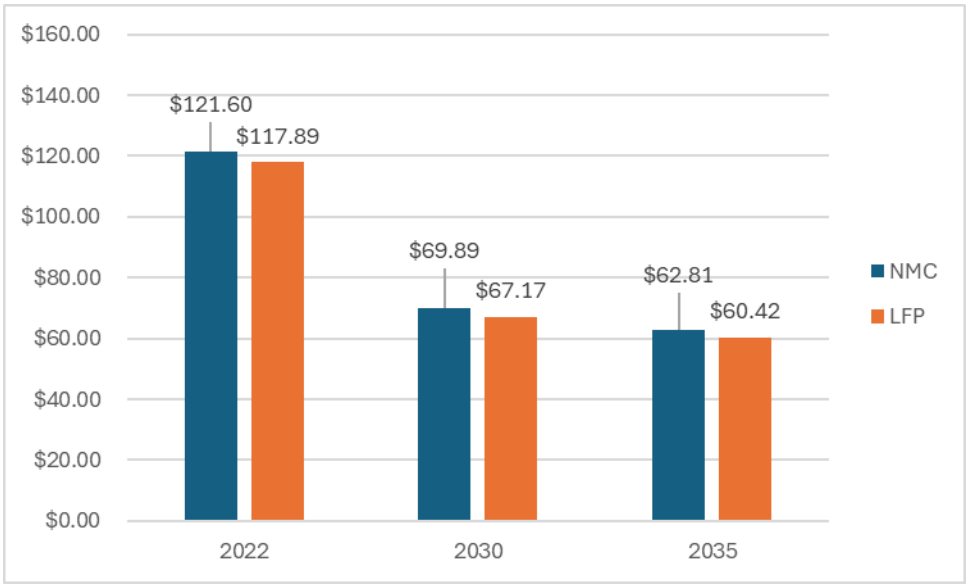


Figure 2: Battery Pack Costs from "Electrification Cost Evaluation of Light-Duty Vehicles for MY 2030" in 2025 Dollars

A second 2023 report, "Alternative Powertrain Pathways for Light-Duty and Class 3 Vehicles for MYs 2024, 2027, and 2035," examined alternative powertrain pathways to meet more stringent CO2 emission targets, and took a slightly different approach to build up the battery pack costs, combining technical learning rates (or experience curve analysis), literature based projection aggregation, and bottom-up modeling using BatPaC and scaling the plant size over time. This method created the following projections for battery cost shown in Figure 3.

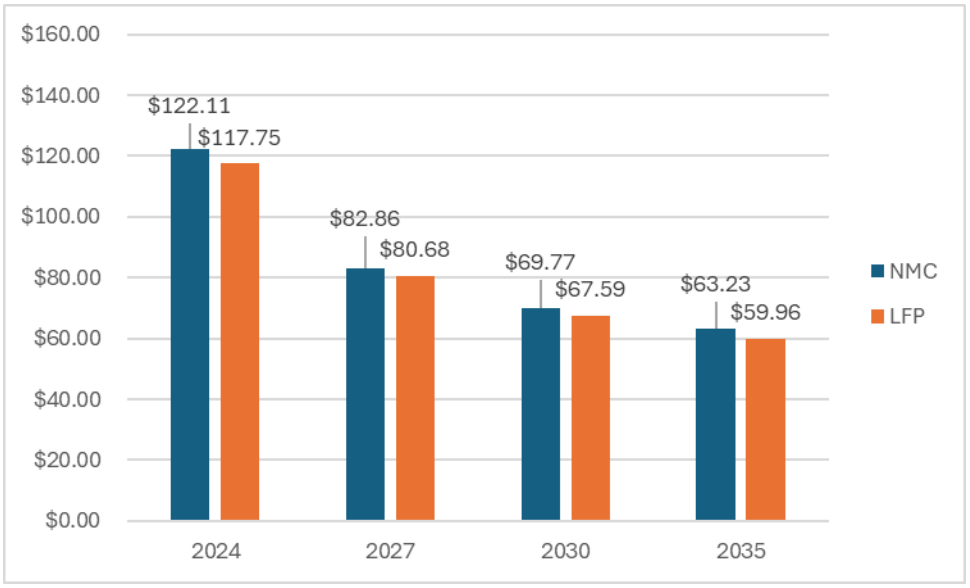


Figure 3: Battery Costs from "Alternative Powertrain Pathways for Light-Duty and Class 3 Vehicles for MYs 2024, 2027, and 2035 to Meet Future CO2 Emission Targets" in 2025 Dollars

For the cost estimations provided in the 2035 timeframe, a factor of 10% savings was applied to account for increased recycling of battery minerals.

2.3 Roush-EDF Projection Summary

The projections made by Roush shown in Figure 1, Figure 2, and Figure 3 are summarized by battery chemistry type and model year in Figure 4. Projections for MY2024 are from both heavy-duty and light-duty reports, which shows as a wide range of projections for that year. The overlapping projections in a given year are from different reports, which may have been using different methods or for a different vehicle class.

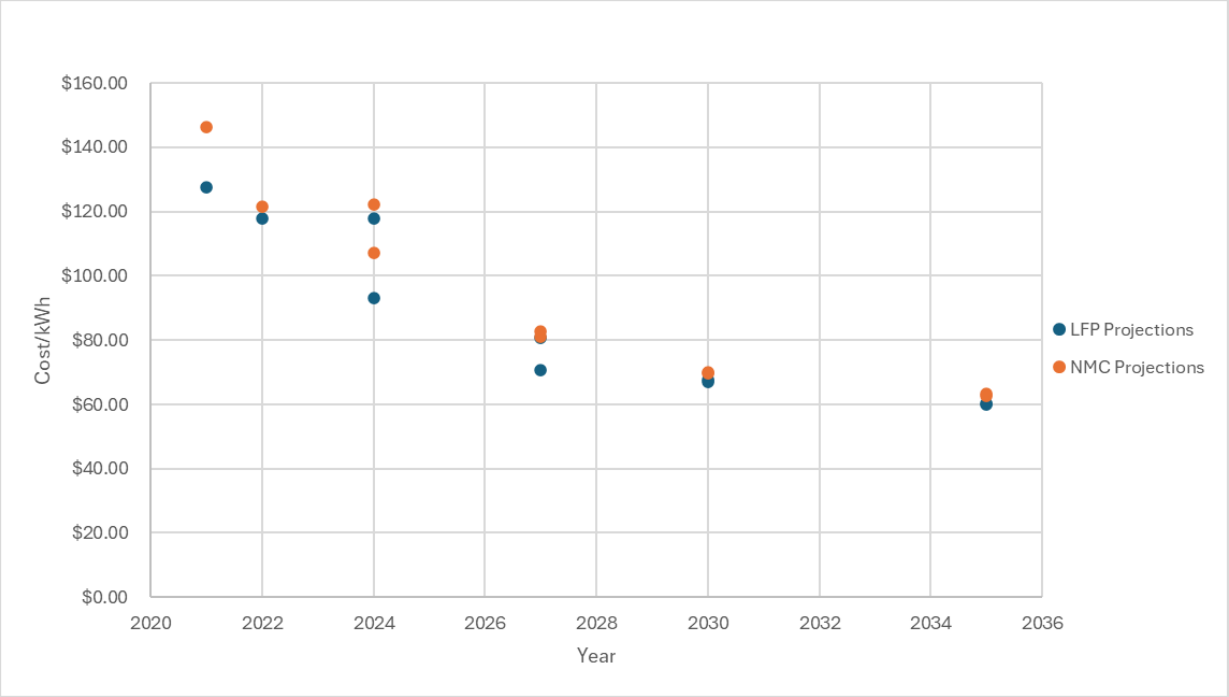


Figure 4: Summary of Roush Battery Cost Projections in Prior Reports

In addition to the continued decrease of battery costs projected, the figure shows a reduction in the difference between LFP and NMC battery costs. LFP batteries were projected in the 2023 LDV report to obtain a significant market share due to their lower cost and improving energy density, and have since gained up to 40% market share in the US EV market. As battery production increases in scale, the convergence of light- and heavy-duty batteries is expected as the architecture for battery packs converges on a common cell factor. Regardless, the projections show a continued reduction in battery cost in the next 5-10 years, increasing the affordability of EVs and other electrified vehicles and helping reach price parity with ICE vehicles.

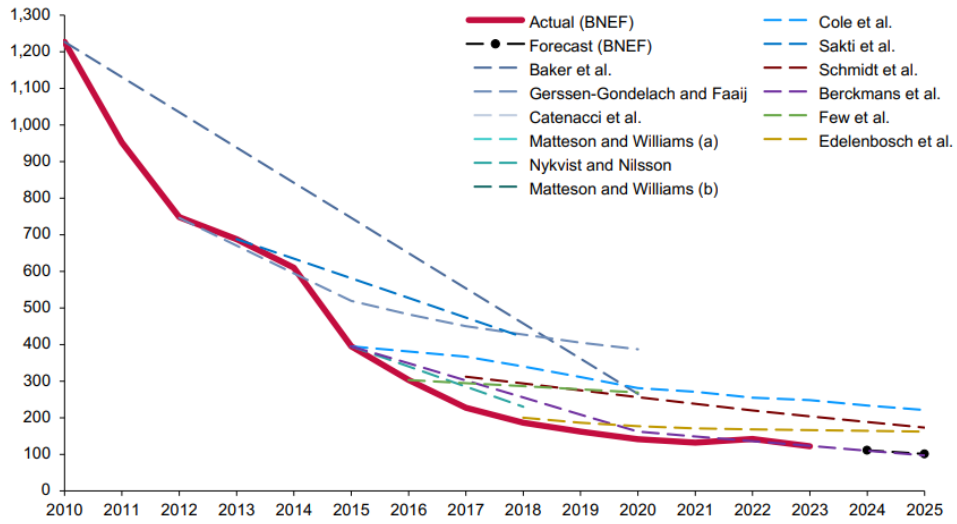
Another trend visible in the forward-looking projections is the decrease in the rate of cost reduction over time. This is expected as production of batteries reaches mass-scale, with massive production and a more mature material supply chain. As the manufacturing learning curve flattens, prices for the current lithium-based batteries will stabilize and become more dependent on the input materials and demand. In addition, recycling developments are poised to reduce the amount of new minerals needed to be mined for a battery, further reducing input costs.

2.4 Comparison to Other Projections

In addition to the estimation provided by ground-up modeling using BatPaC and other sources, a literature review was used in the prior reports to compare projections and predictions.

Battery costs are a common topic of discussion in the automotive world, as increased adoption of EVs are so dependent on the prices of the battery, and thus the vehicle in comparison to PHEVs and ICEVs. A number of projections and discussions on battery costs have been published in recent years. These were taken into account when making the previous projections, and some such as the Bloomberg NEF Battery Outlook [6] are updated each year to reflect current battery costs as well as make new projections based on recent events and trends in the battery manufacturing market.

For the past decade, battery cost projections have consistently overpredicted the price of batteries; in other words, the cost of batteries has fallen faster than predictions. Rocky Mountain Institute and Mauler et. al. 2021 show that actual cost has steadily been lower than predictions, as shown in Figure 5 [7], [8].



Source: Mauler et al. (2021)[64] for expert forecasts of 2010-2018, BNEF Lithium-Ion Battery Price Survey (2023)[65] for actuals and most recent forecasts.

Figure 5: RMI's Comparison of Projections vs Actual Cost From BNEF

Some potential reasons for the rapid drop in battery costs are described in Section 3, but battery prices falling faster than projections is not unheard of. Battery prices in 2023 rose slightly, the first incidence of this in recent history, but then continued to fall in 2024, a trend projected to continue through 2025 and beyond.

Figure 6 shows Roush's projections combined with other battery cost projections from BNEF, Goldman Sachs, DOE, and others.

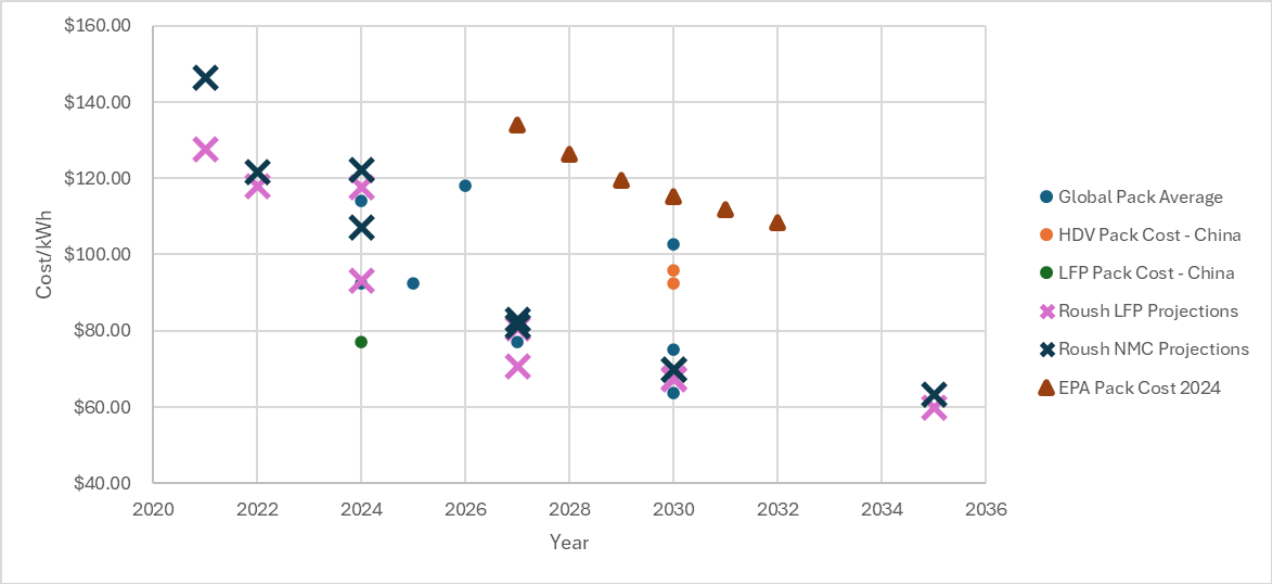


Figure 6: Roush Projections (marked in X's) Compared to Other Projections, and EPA Projections used in 2024 (marked as triangles). All costs updated to 2025 dollars. [2], [3], [4], [9], [10], [11], [12], [13], [14], [15]

Multiple categories of cost projections are shown in this chart for NMC, LFP, and global pack averages across all chemistries. These comparisons show Roush-EDF projections falling in line with most projections in the short term, and on the lower end of projections in 2030. This points to the projections made in 2022 and 2023 by EDF and Roush having high accuracy, including the projection of increased market share for LFP batteries. This can be attributed to a variety of market factors, which are discussed in section 3. Further trends that can be expected are the convergence of LD and HD battery costs, as architectures and chemistries become more uniform across various vehicle types. NMC costs will continue to decrease as other battery chemistries become prominent on the market.

The costs used by the EPA in 2024, however, are far above any projections made by any sources in the 2027-2032 timeframe. The projected costs for batteries in 2030 are already being achieved in 2024 ($115/kWh) according to BNEF. [14] Thus, these estimations of costs in the future timeframe used by the EPA are unreasonably high.

On this current trajectory, we believe that the cost of batteries at a pack level in 2030 to be around $67-70 for current NMC and LFP chemistries. The emergence of chemistries such as sodium-ion or LMR may further drive cost decreases beyond those projected by these studies.

3. Market Forces Driving Battery Costs

3.1 Battery Mineral Inputs

Raw materials and their costs are a major driver of overall battery costs [16]. As the market share of different battery chemistries changes, the opportunity for use of battery chemistries that use cheaper raw materials becomes more prevalent.

Figure 7 shows Goldman Sachs' projection on the battery chemistries used within the global market through 2030. As shown, it is projected that by 2030 the market share of LFP will continue to increase. Growth in battery chemistries such as Na-ion is also projected over this time frame.

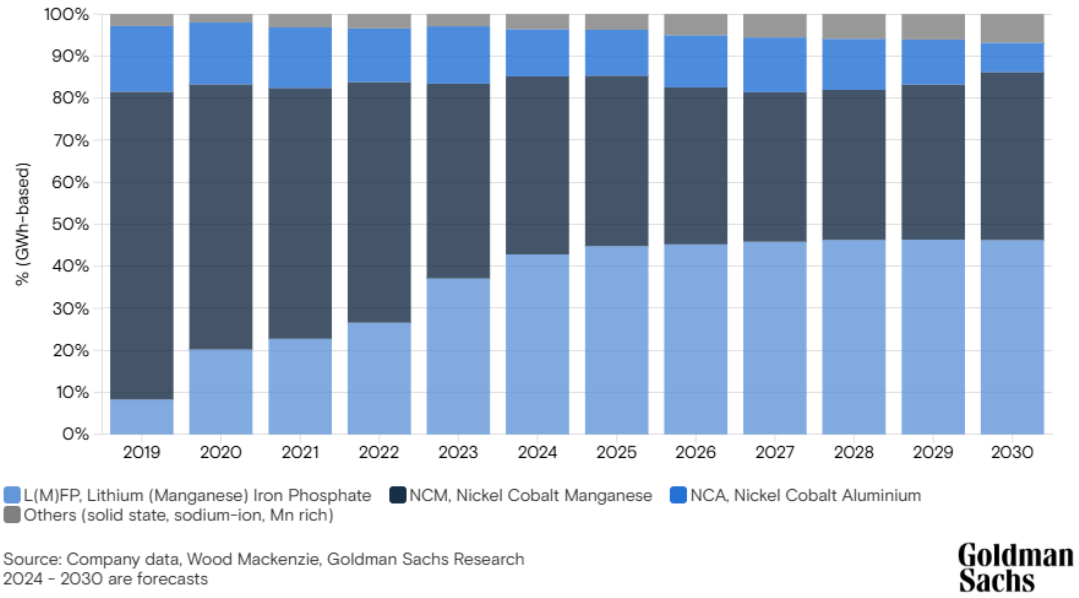


Figure 7: Goldman Sachs' Battery Chemistry Market Projection Through 2030 [17]

As the LFP battery chemistry continues to increase its market share to become the most dominant battery chemistry in the market, the projected demand for cobalt within the battery market can reduce by 50%. This could be significant in driving costs of batteries down as cobalt has higher costs than the other common raw materials found in popular battery chemistries [18]. The supply of lithium in the United States and its existing free trade and critical minerals agreement partners is now projected to exceed the lithium demand for EVs through 2032 by a significant margin, thus driving the price of lithium down [19].

Na-ion is the only current battery chemistry in development for EVs that does not use lithium [17]. While this chemistry does not have a large share in the market, the projected growth and deployment of this chemistry could reduce the demand of lithium by up to

40% in 2035. Reduced lithium demand should reduce costs for lithium, thus further driving lower costs in the battery chemistries that use lithium.

Another opportunity to reduce battery costs within raw materials is the improvement of energy density in batteries. Battery energy density has improved as demand for batteries has grown. This can be attributed to the developments of batteries that corresponds with the demand and the shift to chemistries with higher energy densities. As battery deployment continues to grow, it is expected that battery density can improve by over 25% [16].

3.2 New Battery Chemistries

Along with current battery chemistries becoming further developed, the development of new battery chemistries could also drive down the demand for costly battery materials, and thus, battery prices.

General Motors and Ford have both been developing Lithium Manganese Rich (LMR) battery technologies. This battery chemistry would reduce both nickel and cobalt demand when compared to current NMC battery chemistries, meaning the materials in this battery chemistry would be cheaper than existing nickel-based chemistries. On top of that, the LMR chemistry is projected to have a higher energy density than LFP, therefore requiring less raw materials in the manufacturing of the batteries. These factors will lead to the LMR chemistry being cheaper than existing battery chemistries [20], [21], [22].

3.3 EV Efficiency

Efficiency improvements within EVs could drive lower battery costs. As batteries become more efficient, it allows for the use of smaller batteries within EVs, requiring less materials for each battery and therefore driving the demand of battery raw materials down [16].

It is projected that the advancements of EV efficiency within the United States could halve the amount of electricity consumed per mile by 2050. This trend could drop the per-vehicle battery demand by 30% by 2030 [16].

3.4 Battery Production Capacity

The production capacity of batteries defines the possible supply of batteries and therefore is a direct driver of the cost in batteries. Domestic battery production has been growing and continues to grow as manufacturing improvements continue to be implemented within the United States [23].

As nations compete to be the world's leaders in battery production, it is estimated that the 3.1 terawatt-hours of global battery cell manufacturing capacity is 2.5 times the annual demand for LFP batteries in 2024. This oversupply leads to a drop in battery prices [24].

Battery recycling impacts the production capacity demand of batteries. Through the process of battery recycling, less new battery materials become required as 80% to 95% of minerals within batteries can be recovered through recycling. A strong push on recycling has led to the total battery recycling capacity being sufficient to recycle all batteries at end-of-life through 2030. As of now, it is cheaper to mine new materials than to recycle, but it is expected that costs associated with recycling will decrease as the technologies advance and the societal and environmental advantages of recycling has the potential to drive these improvements [16].

3.5 Logistics Efficiency

Another section of the supply chain where battery costs can be driven down is in the logistics and transportation of battery raw materials. In the United States, the average freight mile sees the truck less than half full. Efficiency improvements in the transportation sector of the supply chain could drive transportation costs down resulting in lower overall costs for batteries as demand for new batteries is reduced by making HDV operation more efficient rather than increasing HDV production [16].

4. Conclusion

While the market outlook for EV adoption has changed since the original predictions made by EDF and Roush, EV battery costs for lithium chemistries has continued to fall, reaching $115/kWh in 2024 [14]. EV adoption has slowed in the intervening years, leading to continued price drops due to increased supply of batteries, primarily from China. Additionally, input mineral costs have dropped sharply from their peaks, reducing costs further. A shift in chemistries has brought LFP batteries into prominence, taking advantage of their lower-cost metals and increasing power density.

Moving forward, Roush and EDF project continued cost drops, in line with other major projections in the marketplace. Though the drivers of decreased costs may be different than expected, continued development in battery chemistries, EV designs, and the achievement of cost parity with ICEVs will drive costs lower and increase adoption rates in the US and abroad.

5. References

[1] "What Is the Percentage of Electric Cars in the U.S.?" Accessed: Aug. 10, 2025. [Online]. Available: https://www.edmunds.com/electric-car/articles/percentage-of-electric-cars-in-us.html

[2] H. Saxena, V. Nair, S. Pillai, H. Saxena, V. Nair, and S. Pillai, "Electrification Cost Evaluation of Light-Duty Vehicles for MY 2030," 2023. Accessed: Sep. 21, 2025. [Online]. Available: https://www.edf.org/sites/default/files/2023-05/Electrification_Cost_Evaluation_of_LDVs_for_MY2030_Roush.pdf

[3] V. Nair *et al.*, "Alternative Powertrain Pathways for Light-Duty and Class 3 Vehicles for MYs 2024, 2027, and 2035 to Meet Future CO2 Emission Targets," Jun. 2023.

[4] V. Nair, S. Stone, G. Rogers, and S. Pillai, "Medium and Heavy-Duty Electrification Costs for MY 2027-2030 Final Report," 2022.

[5] Argonne National Laboratory Science and Technology Partnerships and Outreach, "BatPaC: Battery Manufacturing Cost Estimation." Accessed: Sep. 21, 2025. [Online]. Available: https://www.anl.gov/partnerships/batpac-battery-manufacturing-cost-estimation

[6] BloombergNEF, "Lithium-Ion Battery Pack Prices See Largest Drop Since 2017, Falling to $115 per Kilowatt-Hour: BloombergNEF." Accessed: Aug. 12, 2025. [Online]. Available: https://about.bnef.com/insights/commodities/lithium-ion-battery-pack-prices-see-largest-drop-since-2017-falling-to-115-per-kilowatt-hour-bloombergnef/

[7] L. Mauler, F. Duffner, W. G. Zeier, and J. Leker, "Battery cost forecasting: A review of methods and results with an outlook to 2050," Sep. 01, 2021, *Royal Society of Chemistry*. doi: 10.1039/d1ee01530c.

[8] D. Walter, K. Bond, S. Butler-Sloss, L. Speelman, Y. Numata, and W. Atkinson, "X-Change: Batteries - The Battery Domino Effect," Dec. 2023.

[9] C. Busch, "Fast-Falling Battery Prices Boost Economic Benefits Expected from Heavy-Duty Vehicle Electrification," 2024, Accessed: Sep. 21, 2025. [Online]. Available: www.energyinnovation.org

[10] "Incremental Purchase Cost Methodology and Results for Electric Vehicles | Department of Energy." Accessed: Sep. 21, 2025. [Online]. Available: https://www.energy.gov/eere/vehicles/incremental-purchase-cost-methodology-and-results-electric-vehicles

[11] "Electric vehicle battery prices are expected to fall almost 50% by 2026 | Goldman Sachs." Accessed: Sep. 21, 2025. [Online]. Available: https://www.goldmansachs.com/insights/articles/electric-vehicle-battery-prices-are-expected-to-fall-almost-50-percent-by-2025

[12] “Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles-Phase 3”, Accessed: Sep. 21, 2025. [Online]. Available: www.epa.gov/dockets.
[13] BloombergNEF, “Lithium-Ion Battery Pack Prices See Largest Drop Since 2017, Falling to $115 per Kilowatt-Hour: BloombergNEF.” Accessed: Aug. 12, 2025. [Online]. Available: https://about.bnef.com/insights/commodities/lithium-ion-battery-pack-prices-see-largest-drop-since-2017-falling-to-115-per-kilowatt-hour-bloombergnef/
[14] “Electric Vehicle Outlook 2025 - Executive Summary,” Dec. 2025.
[15] “The Time Is Now A factbook for investors,” 2024.
[16] D. Walter, W. Atkinson, S. Mohanty, K. Bond, C. Gulli, and A. Lovins, “The Battery Mineral Loop The path from extraction to circularity The Battery Mineral Loop,” 2024.
[17] Goldman Sachs, “Electric vehicle battery prices are expected to fall almost 50% by 2026.” Accessed: Aug. 12, 2025. [Online]. Available: https://www.goldmansachs.com/insights/articles/electric-vehicle-battery-prices-are-expected-to-fall-almost-50-percent-by-2025
[18] “Commodity.” Accessed: Aug. 20, 2025. [Online]. Available: https://tradingeconomics.com/commodity
[19] C. Shen, P. Slowik, and A. Beach, “INVESTIGATING THE U.S. BATTERY SUPPLY CHAIN AND ITS IMPACT ON ELECTRIC VEHICLE COSTS THROUGH 2032,” 2024. Accessed: Sep. 21, 2025. [Online]. Available: https://theicct.org/publication/investigating-us-battery-supply-chain-impact-on-ev-costs-through-2032-feb24/
[20] “Why LMR batteries will change the outlook for the EV market.” Accessed: Aug. 20, 2025. [Online]. Available: https://news.gm.com/home.detail.html/Pages/topic/us/en/2025/may/0513-LMR-batteries-outlook-EV-market.html
[21] S. Kothari, “Ford Develops Breakthrough Battery Chemistry After ‘Intense Research,’” Inside EVs. Accessed: Sep. 21, 2025. [Online]. Available: https://insideevs.com/news/757794/ford-breakthrough-lmr-ev-battery-chemistry/
[22] Y. Lin *et al.*, “A review of high-capacity lithium-rich manganese-based cathode materials for a new generation of lithium batteries,” *Inorganica Chim Acta*, vol. 572, Nov. 2024, doi: 10.1016/j.ica.2024.122239.
[23] “Benchmark debuts cell price forecast as US’ LFP pipeline surges | Benchmark Source.” Accessed: Aug. 20, 2025. [Online]. Available: https://source.benchmarkminerals.com/article/benchmark-debuts-cell-price-forecast-as-us-lfp-pipeline-surges
[24] P. Gerke, “Storage is booming and batteries are cheaper than ever. Can it stay this way?,” Factor This. Accessed: Aug. 12, 2025. [Online]. Available:

https://www.renewableenergyworld.com/energy-storage/storage-is-booming-and-batteries-are-cheaper-than-ever-can-it-stay-this-way/