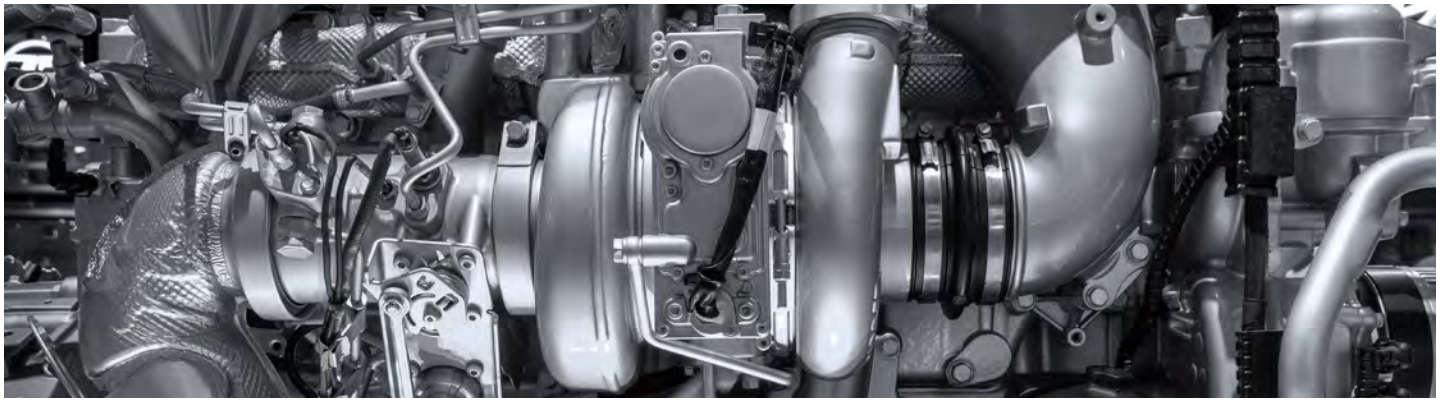
RHEIN REPORT

RHEIN ASSOCIATES

January 2024 Monthly Newsletter



Rhein Associates Forecasts

HIGHLIGHTS

Alternative Fueling Strategies

Fueling both on- and off-highway powertrains in the future will not be from a single solution. Zero-emission powertrains will mix with internal combustion engines as low or near-zero emission options. Use case, geography and cost will all play a part in the future fueling strategies of the industry.

If the solution works, it will grow; the good solutions will work. However, not all solutions will work for all use cases.

COMMERCIAL ELECTRIC VEHICLE OUTLOOK THROUGH 2030

Demand for electric vehicles begins to slow

As we enter 2024, the immediate outlook for electrified vehicles is that of slowing demand. In January, Tesla announced that it missed its last quarter objectives and warned of slowing demand plus increased competition impacting profitability. Ford cut the production of its F150 Lightning by half, moving to single-shift production and diverting resources to meet demand for its profitable Bronco and Ranger ICE models. Separately, both Ford and GM announced that they are pushing their EV model introductions by a year or more.

For commercial vehicles in Classes 2b through 8, demand for EVs is concentrated in a few segments with highest volumes so far in vans, stripped chassis, and school buses. There is a mix of traditional OEMs and start-ups across the segments, and we show how each will perform using our latest quarterly forecast through 2030.

Volvo is the leader in heavy-duty electrified trucks and tractors in Europe and North America by getting its EV products and associated services faster to market. In 2023 Volvo Group delivered almost 5,000 electric vehicles including trucks, buses, and construction equipment globally, but surprisingly noted lower Q4 orders compared with Q4 2022.

Traditional OEMs face competition from start-ups

The advent of electric vehicles has brought new entrants. Tesla's disruption of the status quo in passenger cars is well documented although its commercial truck ambitions have been slower to materialize. Traditional truck OEMs have introduced battery electric vans, stripped chassis, school buses, tractors, and straight trucks, although product rollouts are slower than originally planned.

TABLE 1 – CURRENT PRODUCT MAP (TRADITIONAL OEM)

OEM	Cargo Van	Strip Chassis	School Bus	MD/HD Straight Truck	Tractor
Battle				☑	
Blue Bird		☑	☑		
Stellantis	☑				
Ford	☑	☑		☑	
Freightliner + Thomas		☑	☑	☑	☑
GM BrightDrop	☑				
Hino				☑	
Hyundai					☑
International + IC Bus			☑	☑	
Isuzu				☑	
Kenworth				☑	☑
Mack				☑	
Mercedes-Benz	☑				
Oshkosh				☑	
Peterbilt				☑	☑
Volvo Trucks				☑	☑

Traditional OEMs

- Ford was the first of the Big 3 North American OEMs to produce an electric commercial vehicle with the eTransit in 2022, available in van, cutaway, and chassis cab variants. It is competitively priced, but the current 126-mile range limits acceptance, although USPS has placed a 9,500-unit order in January 2024.
- GM surprised the industry by introducing a radical all-new BrightDrop Zevo 600 large electric van targeted squarely at package delivery. Deliveries of the Zevo 600 started in 2023 and will be supplemented with a

smaller footprint Zevo 400 to help navigate urban areas. The Zevo has excellent range and cargo capacity, but higher pricing than Ford and Ram electric vans.

- Stellantis' Ram ProMaster EV is now released as a delivery van with additional variants coming for 2025. Uniquely, it remains a front wheel drive and its 162-mile range beats Ford. The delivery van features a high-roof, right-side pocket door, and roll-up tailgate for package delivery by Amazon, its first fleet account.
- Mercedes recently introduced the eSprinter van with two HP ratings, giving a longer driving range than Ford or Ram but coming at a $20,000+ price premium over the competition. A wide range of models is available. In addition to limited mileage ranges, all electric vans have reduced payloads compared to ICE vehicles.
- The large van segment is where OEMs have concentrated their initial EV commercial efforts and it is where EV penetration is growing quickly. Ford has launched the F150 Lightning (not included in our forecast that starts with Class 2b) in Class 2a and, GM and Ram are expected to launch comparable products in the category as well. In Class 2b and above, we can expect them to introduce additional EV entries including chassis cabs and pickup trucks.
- Blue Bird is a leader in providing electric school buses and, together with its competitors, will push EV adoption faster than in other segments. Low daily mileage, with return-to-base operation, facilitates school bus EV adoption, as do very generous EV incentives.
- Freightliner offers the broadest range of medium-duty and heavy-duty EVs with eCascadia tractors, eM2 medium-duty trucks, MT50e stripped chassis, and Thomas school buses.
- Volvo's VNR leads in electric tractors with a range of battery options, backed by strong finance and leasing programs, sold through a growing number of EV certified dealers. Mack has an electric medium-duty truck and a Class 8 electric refuse truck.
- PACCAR's Kenworth and Peterbilt divisions have electric tractors and medium-duty trucks plus a Peterbilt refuse truck. Kenworth is also pioneering a fuel cell tractor in California port operations.
- International's first EV entry was with an IC school bus, followed by the eMV medium-duty truck. A regional tractor is planned.
- Hino has introduced electric versions of its medium-duty trucks, and Isuzu will bring to market a Class 5 electric truck later this year. Although Hyundai is not an established truck player in North America, it is evaluating fuel cell tractors in California fleets prior to market entry.
- Specialist manufacturer, Battle has electric refuse trucks.
- Yard spotter trucks, or terminal tractors, are a primary application for electric vehicles because their operation is within very confined areas. Orange leads with EVs, followed by Kalmar-Ottawa, Tico, BYD, and Autocar. These vehicles are primarily used in private yards and not included in our on-highway forecasts.

TABLE 2 – PRODUCT MAP (START-UP OEM)

OEM	Cargo Van	Chassis Cab	Cutaway	Strip Chassis	School Bus	MD/HD Straight Truck	Tractor
Bollinger		☑					
BrightDrop	☑						
BYD						☑	☑
Green Power			☑		☑	☑	
Lion					☑	☑	☑
Mullen		☑					
Nikola							☑
Oshkosh	☑					☑	
REE		☑		☑		☑	
Rivian	☑						
Shyft (Blue Arc)		☑		☑		☑	
Tesla							☑
VIA Motors	☑	☑					
Vicinity motors		☑					
Workhorse			☑	☑			
Xos				☑			

Start-ups' introductions have not gone smoothly, with only a few companies being profitable

New start-up OEMs have entered the industry at a point of disruption and, although entry for most is slower than planned, they are a disruptive force with some gaining footholds in a few segments.

- Rivian is the volume leader supplying package delivery vans to Amazon and being rolled out across North America. Rivian is now expanding its customer base beyond Amazon, starting with AT&T.
- Xos has supplied over 600 stripped chassis walk-in vans for a significant presence in the small volume Class 5&6 strip chassis segment, with plans to utilize a 5,000-capacity production line in Tennessee. The company is to merge with ElectroMechanica, gaining additional capital resources.
- Lion, a Canadian based truck and bus manufacturer, has delivered over 1,600 electric vehicles – the majority being school buses where it claims to be the leading EV school bus supplier. Assembly in both Canada and US has a current capacity of 5,000 units; it also assembles its own batteries in Canada.
- GreenPower, another Canadian start-up, has volume concentrated on China-based EV Star Class 4 chassis cab, cutaway, and bus models with over seven hundred units produced to date, primarily for California. It recently started assembling its Beast school buses in West Virginia. GreenPower also provides a version of its Class 4 units for Workhorse to distribute under its own nameplate.
- Mullen Automotive commenced production of its Mullen 3, a Class 3 LCF truck, and Mullen 1, a light duty van in 2023. Both models are US assembled and rely on significant Chinese content. Mullen is the majority shareholder in Bollinger, with Class 4 and 5 LCF entries starting in 2024.
- BYD is the largest EV truck and bus company globally. It has established EV manufacturing in California with most volume so far in buses. Electric Class 6-8 trucks and Class 8 tractors, based on Chinese designs, are available, but volume has been limited so far.
- BrightDrop is GM's first commercial electric vehicle targeted specifically at the package delivery market with Zevo 600 Class 2b/3 model. Its second model, Zevo 400 is aimed to widen its appeal with significant orders placed by rental and lease companies. Established as a new autonomous GM division, BrightDrop is now being more tightly integrated within GM.
- Nikola has seen much turmoil and management changes since inception. Last year it recalled all its class 8 BEV tractors to change the battery module. Nikola is now focused on fuel-cell Class 8 tractors and has

received orders from major truck fleets. Limited fueling structure and company credibility, coupled with significant company overhead expenses, are big impediments in the short term.

- Oshkosh is not a true start-up, as it is an established manufacturer of military and specialist vehicles. However, it is developing new electric refuse, fire, and specialty vehicles, but its big EV volume play is the USPS contract for 45,000 electric postal vehicles. From 2027, the Post Office will purchase 100% electric postal vehicles.
- REE is an Israel-based start-up with product development centered in the UK. The company has developed an innovative LCF type product that can address a wide range of applications. Production is promised for 2024.
- Shyft is developing a Class 3-5 Blue Arc EV range of products, including stripped chassis and chassis cabs. It has an agreement with Rush – the largest truck group in North America – to distribute and provide after-sales support.
- Tesla's entry to Class 8 is limited to trial units, primarily with PepsiCo. Start of full-scale production of the Semi has been delayed and may be delayed further given Tesla's other priorities.
- Workhorse was one of the initial start-up companies developing commercial electric vehicles, but plagued with product development issues which is delaying its entry. In late 2023, its W56 step van entered production supplemented by a Class 4 W750 chassis cab based on GreenPower's EV Star. A W56 large van stripped chassis is planned for 2024.
- VIA has designed a skateboard electric chassis for use in Class 2b through 5 cargo vans, chassis cabs, and buses, and partnered with EAVX for commercial body upfits of complete vehicles. Production has been slow to start.
- Vicinity (VMC) is a Canada-based supplier of electric vehicles, in addition to its established CNG and clean diesel bus entries. Its VMC 1200 electric vehicle is a Class 3 LCF truck entry with significant Chinese content.

What are the factors that will drive commercial EV Adoption?

Opportunity Segments

Unlike ICE powertrains which are used across all applications, electric powertrains are currently better suited for select product segments. Electric vehicles currently have a limited range of 100-300 miles a day ideally with return to base/depot to facilitate charging. Based on these requirements Vans, School Buses, Regional Haul Tractors, and Refuse Truck applications emerge as the best suited application for BEVs in the near to mid-term.

Government Programs and Incentives

Both federal and state governments have incentive programs for fleets to transition from ICE powered vehicles to EVs. Below are the most prominent ones:

- **Inflation Reduction Act 2022:** The Inflation Reduction Act 2022 has a direct impact on commercial vehicle industry as it promotes domestic green energy production and incentivizes local production of Zero-emission vehicles.
- **Advanced Clean Trucks (ACT) Rule:** In June 2020, the CARB states adopted Advanced Clean Trucks rule which promotes the sales of Zero-emission vehicles (ZEV) in their jurisdictions. As per this rule, 75% of vehicles to be sold in CARB states will be ZEVs by 2035, which will increase to 100% by 2040. It is estimated to save around USD 8.9 billion in health savings between 2020 and 2040.
- **Advanced Clean Fleets (ACF) Rule:** The ACF rule sets forth electrification targets based on fleet types. For instance, starting 2024, 50% of all new state and local government vehicle purchases will be ZEVs and, from 2027, all new purchases will be ZEVs.

Stricter Emission Standards impact vehicle prices

In addition to ambitious EV adoption goals, governments have set out targets to lower emissions from ICE-powered vehicles across the globe. The US Government plans to roll out stricter emission norms in 2027 and 2030. Compliance requires OEMs to introduce new ICE emission technologies, increasing prices of ICE vehicles and narrowing the gap with EVs as their costs are expected to decline. Price parity with ICE counterparts in total operating costs should be attainable by 2030 for some users. High acquisition cost is one of the biggest barriers in widespread EV adoption, but

generous incentives help reduce the disadvantage. However, the current elevated level of EV incentives is not sustainable in the long-term, forcing OEMs to reduce costs.

Growing pool of EVs available

The unavailability of EVs to meet many fleet requirements has hindered adoption, but with more products available from existing and start-up OEMs, there will be a wider choice of EV offerings. In 2020, there were 20 EV nameplates between Class 2b to 8 which grew to forty-five by 2023 and expected to double again by 2030.

Infrastructure Development

The US currently has 71,700 EV charging stations compared to 145,000 fueling stations. The critical statistic to compare is the number of Electric Vehicle Supply Equipment (EVSE) that these charging stations represent. As per AFDC's latest data, there are close to 189,000 EVSEs in the US compared to at least 900,000 fueling pumps (assuming six pumps/station as an average). However, reliability of charging stations is inferior to gasoline or diesel fueling and time to charge is longer and more inconvenient than conventional fueling. The US Government has announced that, under the Infrastructure Investment and Jobs Act of 2021, it will invest USD 7.5 billion in charging infrastructure by building a national network of 500,000 public chargers by 2030.

These programs, plus incentives to install charging infrastructure, are stimulating demand for EVs which are expected to account for 15.6% of all Class 2b-8 production in North America by 2030.

What are the factors that will hinder commercial EV Adoption?

Traditional OEMs' advantage

Rise of EVs led to the leveling out of the playing field in terms of technical expertise as both new and established OEMs scampered to gain advantage in the market. While that may be true for technology, there are other facets where traditional OEMs have a strong advantage such as resources, brand identity and loyalty, and dealership and service network. For instance – Tesla has positioned their Class-8 Semi as the segment leader in terms of driving range, performance, and safety technology. This has helped them garner attention from one of the country's largest private fleet operators, PepsiCo.

Traditional OEMs have strong customer relationships and the marketing and financial power to introduce full-service lease packages, to help cushion the EV price disadvantage, and support customers after-market with wide dealer support.

EV Demand Slowing Down

Despite the rising demand for commercial EVs in recent years it has fallen short of initial OEM expectations. Introduction dates have frequently been delayed and unsold inventories of have led to slowed production.

There are several reasons why EV demand has failed to live up to expectations – the most prominent being range anxiety, inflated cost of acquisition, long charging times, and lack of adequate charging infrastructure. There is also considerable hesitancy about long-term reliability, potentially high battery replacement costs, and residual values. For now, many commercial users are watching from the sidelines.

However, over the next 5 years, we will continue to see new and improved products to help mitigate EV disadvantages, that will grow EV penetration in Class 2b through 8 from <2% in 2023 to 15% by 2030, at a CAGR of 37%.

Input costs still higher than previous estimates

EV input costs have remained high despite a decline in battery materials. Lithium prices have fallen over 80% since the end of 2022 and are close to their 2021 prices, however, lithium-ion (Li-ion) batteries which consist mostly of Lithium have not seen a decline as sharp. As per BloombergNEF's annual battery price survey, average Li-ion battery prices dropped by ~14% in 2023. Battery manufacturers have cited lower demand than anticipated leading to lower

utilization rates for their plants as the reason behind battery prices remaining high. It is estimated that battery prices will come down to USD 80/kWh by 2030 as compared to USD 139/kWh in 2023.

Prototype to Production

Most start-up OEMs are new to automobile manufacturing and have struggled to take their products from prototype to commercial production. Nikola, which is one of the earliest EV truck manufacturers in mid-2023, issued a recall for TRE Battery Electric Vehicles (BEV) it had produced till date, citing a potential fire hazard. The recall includes replacement of batteries in all these BEVs and is set to cost Nikola approximately USD 62 million. The company stopped sale of its BEVs, resulting in a threefold increase in its gross losses, from USD 59 million over Jan-Sep 2022 to USD 176 million over Jan-Sep 2023.

Financial stability of start-ups

Start-up OEMs benefited from the rush to invest in any type of EVs with an abundance of capital leading to grossly inflated stock prices. The tremendous difficulty in bringing all innovative technologies to market, and then producing them on a scale, was never understood with the result that most start-ups are suffering financially. Stock prices are a fraction of their former highs while capital costs have increased. Additionally, prices of key components from suppliers have increased, especially for low volume producers.

One of the advantages of a start-up is speed to market without being encumbered with traditional model development practices. However, almost no start-up EV has delivered in line with initial expectations, allowing traditional OEMs to bring competitive products to market.

There are a reduced number of start-up players: ELMS exited in 2022, Mullen acquired 60% of Bollinger, Lordstown Motors wound up in 2023, Arrival is looking for a buyer without getting its van into production, Proterra filed for bankruptcy and being assimilated by Volvo, and in December, Lightning Motors, who had been converting ICE stripped chassis and Class 4 cutaways to electric, declared bankruptcy. There will be more to come. The remaining start-ups have abandoned grandiose schemes and instead focused on specific product segments. This has proved a winning strategy for Xos who started as a Class 8 entrant but reoriented to stripped chassis and step vans where it has EV leadership and is among the first gross margin positive commercial EV manufacturers.

Reality Check – Who is using Commercial EVs?

According to Environmental Defense fund, as of October 2023, there were 11,965 commercial EVs operating in private fleets and 1,203 in public fleets. The chart below shows the top 10 EV users in each category. Amazon accounts for almost 84% of the private with over 10,000 units operating, followed by FedEx, Ryder, and Pepsi Frito-Lay, and just twenty units gets Reyes Coca-Cola into the top ten. Beyond the top ten, there are many large fleet companies operating electric vehicles, but the majority are operating a few trial units with a modest commitment to EVs thus far.

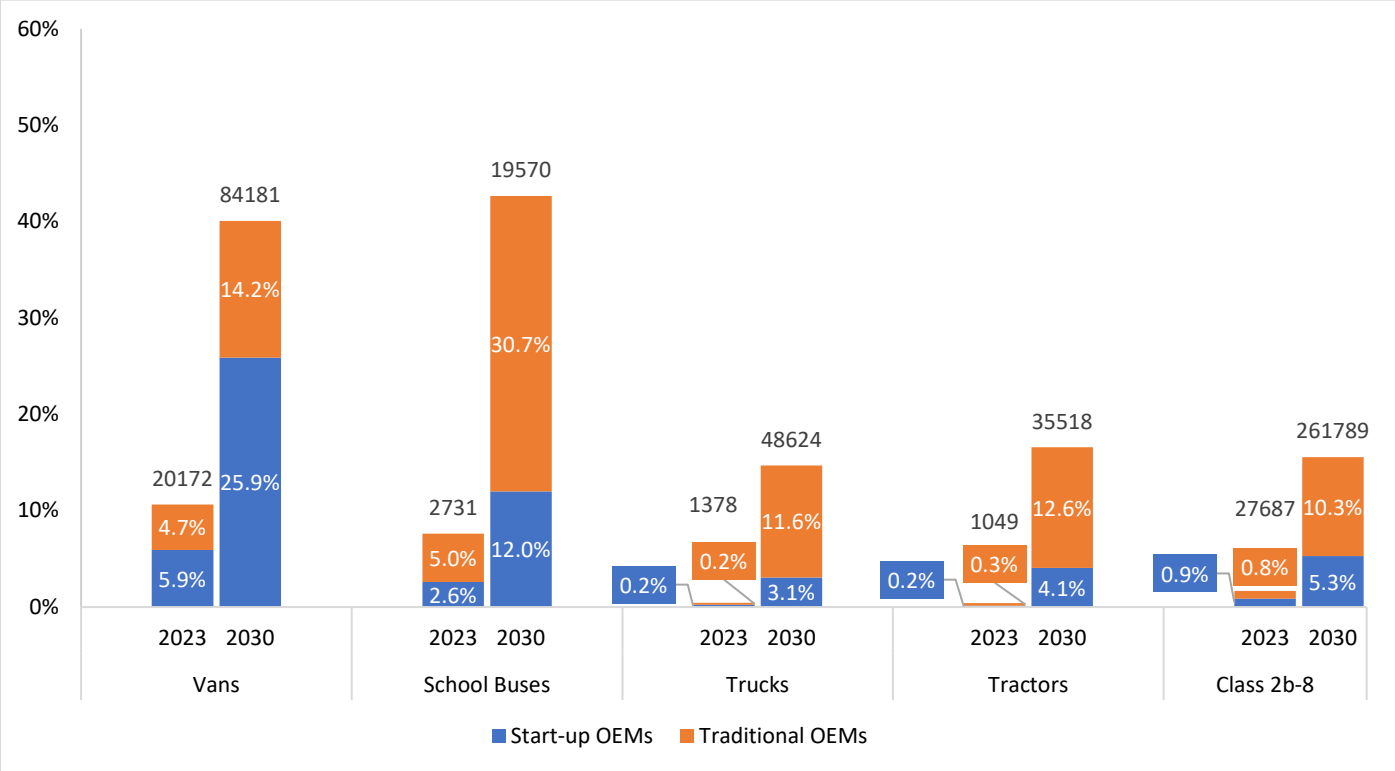
Of the public fleets, New Your City's combined fleet operations leads by a wide margin with school districts featuring prominently in the remaining top ten.

TABLE 3 – FLEETS USING EVS IN THE US

Private Fleets	11965
Amazon	10010
FedEx Corp.	651
Ryder Systems, INC.	207
Pepsi Frito-Lay	170
Schneider National Inc.	114
DHL Supply Chain	121
Merchants Fleet	58
US Foods	30
Performance Team	30
Reyes Coca-Cola Bottling (RCCB)	20

Public Fleets	1203
New York Citywide purchases combined	554
Pinellas Suncoast Transit Authority (PSTA)	62
Broward County School District	60
Anaheim Transportation Network	62
Washington State Schools	40
Port of Long Beach	33
Capital Metro Transportation Authority	26
Pioneer Valley Schools	25
Boston Public Schools	20
Miami-Dade County Schools	20

CHART 1 – START-UP OEM VS TRADITIONAL OEM EV PRODUCTION, BY TYPE, NORTH AMERICA, % SHARE OF CLASS 2B-8 CV PRODUCTION, 2023-2030



In our forecast, start-up OEMs' Class 2b through 8 EV production in North America exceed 90,000 units by 2030, compared to 14000 in 2023. Vans are forecast to have the highest EV volume with penetration at 40% of the total which includes BrightDrop, Rivian, and Oshkosh in the start-up category. School buses are projected to have the highest EV penetration with 43% in 2030. Truck EV penetration is forecast at 14.7%, mostly medium-duty, and tractors at 15.6%.

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HIGHLIGHTS from ACT N.A. COMMERCIAL VEHICLE OUTLOOK – January 2024

FORECAST SUMMARY

The biggest changes to ACT's forecast this month were tweaks to current year's assumptions for Class 8 tractor production as November data flip from forecast to actual.

The Class 8 forecast has anticipated a measured production slowdown beginning in Q1 and extending to Q3. As the worst of the inventory stockpiling surge won't occur until January and February, we are probably early in our call for build rate cuts sooner.

NORTH AMERICA ECONOMY

As we focus on 2024, our underlying economic outlook remains steady – we continue to look for short- and long-term growth just below 2%, in line with "potential" growth.

Conditions from the post-pandemic economy should begin to normalize after 2024. Stretching the horizon to look beyond 2024, our outlook anticipates continued trend growth.

Based on more complete data, the BES estimates the US economy grew at 4.9% in Q3'23 on a q/q SAAR basis, down slightly from the second revision of 5.2%.

MEDIUM DUTY MARKET

The medium-duty market saw much-needed relief in November. Both production and sales improved sequentially, as did forward-looking net orders. All three of these gains were counter to seasonal expectations.

December's preliminary net orders of 23,100 MD trucks (+9.2% m/m) was the highest since August 2021 and likely represents full opening of the 2024 order-board.

HEAVY DUTY MARKET

One of the factors that will be weighing on production in short order is a growing inventory overhang.

A rapid, 20K inventory surge into the end of Q1 is not desirable and is likely to drive sharp production cuts by Q2.

We note that downward movement in 2024 expectations will generally have negative implications for our 2025 production call.

TRAILER ORDERS

Peak order season opened in September, and although net orders in November continued to show relatively healthy bookings, they were softer than the previous two months. Unlike the last few years with challenges solidifying on the supply side of the pendulum, the trailer industry's concerns now rest on the demand side.

November net orders, at 21,100 units, were 47% lower y/y, and more than 14K units less than were booked in October. With 35% of the year's orders historically booked in Q4, the quarter's seasonal factors run roughshod on the nominal data.

Despite being in the third month of peak order season, build outpaced orders in November by about 2,500 units.

Fleets commitments were mixed but overall improved in November. Total cancellations decreased to 0.9% of the backlog, from October's 1.2% level, improved but still slightly elevated for some segments more than the orders.

TRANSPORTATION SECTOR

We see limited initial impact from the ocean disruptions on truckload rates, but changing ocean and inventory dynamics support higher airfreight and intermodal demand, and intermodal spot rates could continue to rise.

While the freight industry deals with crises every day, the disruption of two primary routes for US imports from Asia is major. The Panama Canal and Suez Canal account for over 40% and 15% of US import fright, respectively.

With interest rates elevated, companies generally aren't itching to add inventory. But we don't need a retail restock for the inventory cycle to support freight growth in 2024.

The record declines in TL rates since early 2022 are cautionary signals for the tractor demand outlook in 2024 and early 2025. We forecast lower supply in 2024, helping push the rate cycle higher in 2025 and supporting our 2025/2026 prebuy expectations.

USED EQUIPMENT

November same dealer used Class 8 retail truck sales declined (~4.6% m/m), though not nearly as much as history might have suggested.

Industry, Economy, and Legislation

Class 8 truck orders in December were lower than expected, but the five-and-a-half months it takes to build and deliver a new unit remained relatively stable. Strong orders for vocational trucks, Mexico demand, and exports softened slack bookings for over-the-road tractors.

The US Environmental Protection Agency (EPA) has awarded nearly USD 1 billion to 67 applicants for its Clean School Bus Program Grants Competition, which will purchase over 2,700 clean school buses. Nearly 95% of these buses will be battery electric vehicles, in 280 school districts across 37 states.

US retail sales for medium-duty trucks increased 9.1% YoY in December, reaching 22,857 units, up 8.4% YoY from 2022. Class 4–7 saw sales jump 18.6% compared to the total units sold in November. The Class 4-5 segment saw sales rise by 37.5% to 12,141 units compared to December 2022. Also, YoY sales for Class 7 dropped by 7.9% and for Class 6 by 14.1%.

According to a report from Calstart, California leads in zero-emission truck (ZET) adoption, with around 3,075 trucks deployed through June. However, other states, including Texas, New York, Florida, and Illinois, are moving more battery-powered trucks in certain segments.

The US Department of Energy has allocated USD 60 million to the US Advanced Battery Consortium to develop lightweight, lower-cost batteries for electric trucks. The remaining USD 71 million will be split across 27 projects, including lithium-sulfur battery tech for startups Lyten and Zeta Energy and manufacturing company Coherent. These companies aim to reduce battery costs and increase the driving range for electric vehicles.

Heavy-duty electric trucks struggled with volume growth last year due to lagged charging infrastructure, battery recalls, and financial issues. However, real estate developers invested in charging depots, single-charge driving range improved, and a battery-making startup achieved over 600 miles on a single charge.

Vocational trucks, Mexico demand prop up Class 8 orders

The overcapacity of on-highway trucks would look worse without underlying support from Mexico and strong vocational demand.

US EPA announces nearly $1 billion in awards for clean school buses

The US Environmental Protection Agency (EPA) announced the selection of 67 applicants to receive nearly $1 billion through EPA's first Clean School Bus Program Grants Competition. The funding will help purchase over 2,700 clean school buses-95% of which will be battery electric vehicles-in 280...

December Medium-Duty Sales Rise 9.1% Year-Over-Year

U.S. retail sales for medium-duty trucks rose 9.1% year-over-year in December while finishing 2023 some 8.4% higher than 2022's full-year total…

Zero-emission truck adoption soars - and not just in California

California leads zero-emission truck adoption, but other states are growing faster in certain types of commercial EVs.

Electric truck development gets $131 million boost - sulfur is a winner

DoE's latest round of funding includes millions for OEMs like Cummins and Paccar to earmark for electric truck battery research.

Electric trucks should shake off setbacks in 2024

Electric trucks and charging infrastructure should advance this year without some of the growing pains that held them back in 2023.

Electrification

The US DOE has allocated USD 32.5 million to 16 projects aimed at achieving net-zero greenhouse gas emissions in the transportation sector, focusing on EV deployment, charging infrastructure, and consumer education.

Mississippi lawmakers approved USD 365 million in state incentives for Accelera by Cummins, Daimler Truck, and Paccar Inc.'s USD 2 billion battery-making joint venture, aiming to create 2,000 manufacturing jobs and secure local supply for lithium iron phosphate batteries, reducing reliance on Chinese imports.

The US Post Office plans to install hundreds of electric vehicle charging stations at its South Atlanta Sorting and Delivery Center. The first battery-powered vehicles, made by Ford Motor Company, will be deployed in Georgia and other parts of the country.

Zerova Technologies introduced its MegaWatt Charging System for commercial heavy-duty vehicles at CES 2024, capable of supporting up to 3.75 megawatts, 3,000 amps, and 1,250 volts. The integrated platform combines hardware and software with onboard applications for ease of use.

Wave Charging will deploy its 500kW wireless BEV charging system in cold climates for the first time, charging a Class 8 electric truck in less than 15 minutes. The system, developed in collaboration with Cummins and the Department of Energy, claims to offer comparable efficiency to wired charging.

Costco's partner Trinity Structures has successfully deployed the first off-grid electrified structures for its fleet in Mira Loma, California. By 2035, Costco aims to replace the deploy yard trucks with alternative fuel models.

DOE announces $32.5M in funding for 16 projects to advance transportation electrification

The US Department of Energy (DOE) selected 16 projects for funding totaling $32.5 million to advance technology integration in areas critical to achieving net-zero greenhouse gas emissions in the transportation sector.

Cummins, Daimler and Paccar pick Mississippi for $2B battery joint venture

Mississippi incentives helped lure a $2 billion advanced battery-making joint venture for electric trucks to the Magnolia State.

USPS Installs EV Chargers in Atlanta, Will Expand Nationwide

This week, USPS unveiled its first set of EV charging stations at its South Atlanta Sorting and Delivery Center, the first of hundreds that will be installed at centers nationwide this year.

Zerova Unveils MegaWatt Charging System at CES 2024

Zerova Technologies debuted its MegaWatt Charging System for commercial heavy-duty vehicles at CES 2024. The company said it will support up to 3.75 megawatts, 3,000 amps, and 1,250 volts.

Wave to Deploy 500kW EV Charger in Cold Climates

Wave Charging will deploy its 500kW ultra-fast wireless BEV charging system, developed in conjunction with Cummins and the Department of Energy, in cold climates for the first time.

Trinity Structures Deploys Off-Grid Integrated Charging Structures for Costco

Trinity Structures, Costco's electrification partner, has deployed the first off-grid electrified structures for Costco's fleet in its largest distribution center in Mira Loma, California.

Autonomy and Technology

Kodiak Robotics unveiled its first driverless-ready semi-truck for scaled deployment at the 2024 CES technology trade show. The Class 8 tractor features redundant safety-critical hardware and software.

Nikola's hydrogen fuel-cell electric truck, featuring ZF's automatic emergency braking and radar-based blind spot detection, is the first application of these driver-assistance technologies for the North American market.

Western Star Trucks has introduced new safety features for its vocational models, including the X-Series, 47X, and 49X. These models now offer Detroit Assurance with Active Brake Assist (ABA5), a standard feature for fleets regardless of powertrain, and a factory-installed backup alert system for enhanced driver comfort and safety.

At CES 2024, the focus was on autonomous, electric, and connected vehicles, emphasizing the importance of trucking sensors in enabling vehicle monitoring. Techniques included sensors, radar, sonar, lidar, and cameras.

Kodiak Unveils Semi-Truck Designed for Scaled Driverless Deployment

Kodiak Robotics has introduced its first driverless-ready semi-truck designed for scaled deployment.

Nikola Building ZF Safety Systems into FCEV Truck

Nikola’s hydrogen fuel-cell electric truck will feature ZF’s automatic emergency braking and radar-based blind spot detection systems.

Western Star Vocational Trucks Add Safety Features

Western Star Trucks, a Daimler Truck North America LLC brand, announced its latest safety features available for its vocational models, Western Star X-Series, 47X and 49X.

Progress in Sensor Technology for Trucks Showcased at CES

LAS VEGAS - Trucking sensors are becoming an increasingly pivotal area of focus as an enabler of automotive technology, with that growing importance demonstrated at CES 2024.

Hydrogen

Isuzu Motors and Honda are conducting demonstration-testing their Giga Fuel Cell system on public roads in Japan, aiming to collect data and identify technical issues on fuel-cell-powered trucks. The testing is scheduled to run through September.

Bosch is expanding its hydrogen propulsion strategy, including plans for a hydrogen internal combustion engine, to address the growing global energy demand straining resources. The company is focusing on developing alternative fuels, such as hydrogen fuel cell powertrains, to more efficiently utilize resources and contribute to a more sustainable future for trucking.

Auto2x highlights hydrogen's potential in zero-emission automotive strategies, with a Total Addressable Market (TAM) of USD 185 billion by 2026. However, the application of hydrogen as a transportation fuel is still in its infancy due to high production costs, challenges in handling and distribution, and complex value chains.

Hydrogen gained attention at the Advanced Clean Transportation Expo and Consumer Electronics Show. Global automakers like Hyundai and Tier 1 suppliers like Robert Bosch plan to incorporate hydrogen into fuel cells and engines. Hyundai envisions a logistics ecosystem using fuel cell-powered trucks for electric vehicle transportation and heavy-duty equipment.

Isuzu and Honda Testing Fuel Cell Truck in Japan

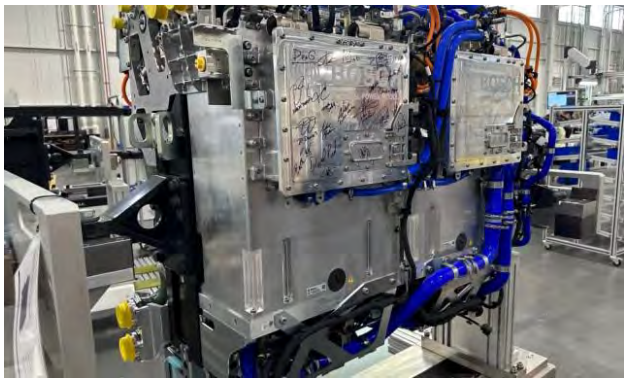
In late December, Isuzu Motors and Honda began demonstration-testing their jointly developed Giga Fuel Cell system on public roads in Japan.

Bosch Bets on Hydrogen for EV Trucking Future

Bosch has gone all-in on hydrogen, seeing it as a key pathway to making trucking more sustainable, executives at the company explained Jan. 8 during CES 2024.

Hydrogen Fuel Cells will record strong growth by 2040 to power Heavy-Duty Trucks and clean logistics, finds Auto2x

Auto2x maps the innovation landscape and competition in Hydrogen Mobility to identify promising opportunities, such as hydrogen-ICE, SOFC, HT-PEMs and Green H2



Hydrogen rises at CES

Hydrogen was a big topic through the mobility and transportation space at the Consumer Electronics Show in Las Vegas.

Off-Highway

The JCB Digatron, a nine-liter supercharged engine, is based on the JCB backhoe loader and is built from the foundations of a standard Monster Jam truck. The truck, over ten feet tall, 12 feet wide, and 17 feet long, is powered by a nine-liter supercharged engine that generates 1,500PS and 1,790Nm of torque.

All Crane group is set to receive five of Liebherr LRT 1130-2.1 Rough Terrain cranes, the company's third Rough Terrain model. The 130-tonne cranes, unveiled at Bauma in October 2022, feature a 60-metre main boom, bi-fold swing away extension, and a 2.9-metre assembly jib. The first units are expected to arrive in the next month or two.

Komatsu has announced the launch of a 13-ton all-electric excavator, the PC138E-11, set to be sold in domestic and European markets in early 2021, aiming for carbon neutrality by 2050.

Caterpillar has partnered with CRH to accelerate the deployment of its zero-exhaust emissions solutions, including 70 to 100-tonne-class battery electric off highway trucks and charging solutions, and to provide customer feedback on safety, performance, operational, and compliance requirements.

Komatsu is promoting hydrogen fuel cells as a low-carbon alternative to diesel engines for mining trucks. The company claims that these trucks can pack large amounts of energy without compromising payload capacity, simplifying the challenges of sizing, and deploying hydrogen refueling infrastructure.

Empire Crane has received two new Jekko articulating crawler cranes: the JF545 and the JF990. The JF990 is the largest transportable crawler, with a 21-tonne lifting capacity and 34-meter reach and comes with a man basket.

The Digatron is JCB's new Monster Jam Truck

Take a look at this: the latest monster truck for the US-based Monster Jam series. It's the JCB Digatron, and isn't it the coolest thing JCB has ever built..?

First 130t Liebherr RT shipped

US based All Crane group is set to receive five of the first 130t Liebherr LRT 1130-2.1 Rough Terrain cranes

Empire gets Jekko crawlers

Crane dealers takes delivery of two articulating crawler cranes.

Caterpillar to electrify largest North American aggregates producer

Caterpillar has signed a strategic electrification agreement with North America's largest aggregates producer, CRH. Together the partners will advance the deployment...

GM and Komatsu collaborate on hydrogen truck

Komatsu and General Motors are working together in the USA on the development of a hydrogen fuel cell power module for Komatsu's 930E electric drive mining truck.

New Komatsu All-Electric Excavator set to debut in European Markets

Komatsu has revealed details of a new all-electric excavator which they confirm is destined for sale in their domestic and European markets early in the year ahead. The 13-ton class PC138E-11 will ...

Truck OEM

Volvo has released a new video teasing a new truck, the VNL, in zebra-stripe camouflage. The truck features a taller, wider front grille, an aerodynamic rear-sloping roofline, autonomous driving sensor arrays, and design cues from the Volvo SuperTruck 2, attracting curious truck drivers at an unidentified truck stop.

Tech startups Aurora Innovation and Kodiak Robotics showcased their autonomous Class 8 truck designs at CES 2024, aiming to deploy them in their first fully driverless commercial operations. Despite prototypes already hauling freight, safety drivers are still in the driver's seat.

Mullen Automotive has developed a lightweight service truck body for the All-Electric Mullen THREE, in collaboration with Phenix Truck Bodies & Van Equipment and Knapheide Manufacturing, offering an EV solution for Class 3 fleets.

Peterbilt Motors Co. showcased its SuperTruck II demonstrator vehicle at the ATA Management Conference and Exhibition in San Diego, featuring an aerodynamic shape, center drive position, pop-out windows, cameras, custom tires, and a mild hybrid powertrain. The vehicle also features a lightweight chassis for improved fuel economy.

LAUSD has ordered 180 electric, zero-emission school buses from Blue Bird Corporation, marking the largest order in the company's history. The first buses are expected in October 2024, with the first buses expected in early 2025.

Kenworth and Peterbilt are recalling 11,053 medium-duty trucks due to improperly seated glass on cab mirrors. The recall began in August after field failures and warranty reports. Paccar Inc. reported 181 warranty claims and 12 trucks in the field affected. The recall also includes 2022-2024 Kenworth T180, T280, T380 and T480 models built in the same date range. The plant in Sainte-Thérèse, Quebec, is now inspecting the mirror lock ring.

Volvo Teases All-New VNL Class 8 Tractor

The New Year is off to a bang on the heavy trucks front with Volvo Trucks North America announcing that it will debut an all-new, Class 8 VNL tractor later this month.

Autonomous Trucks Show Progress at CES

The pathway toward large-scale commercialization of self-driving trucks became clearer at CES 2024 as tech startups unveiled upgrades to their autonomous driving systems.

Mullen Completes Class 3 Light-Weight EV Service Body

Mullen Automotive has completed a lightweight service truck body for the All-Electric Mullen THREE, developed in collaboration with Phenix Truck Bodies...

Peterbilt rolls out its SuperTruck 2, autonomous truck at ATA MCE

Peterbilt Motors Co. showcased its advanced technology vehicles at the American Trucking Association's (ATA) Management Conference and Exhibition (MCE) show in San Diego, California.

Los Angeles Unified School District orders 180 Blue Bird electric buses

Los Angeles Unified School District (LAUSD) ordered a record 180 electric, zero-emission school buses from Blue Bird Corporation, including 150 All American and 30 Vision model buses.

Kenworth and Peterbilt recall medium-duty trucks over mirror glass seating

Paccar is recalling 11,053 medium-duty trucks because an improperly seated mirror glass lock ring may allow glass to fall out.

PERIODIC ECONOMIC/MARKET INDICATORS

GDP

(Chained (2012) Dollars)
Seasonally Adjusted at Annual Rates

2022 CY	*2022 Q4*	*2023 Q4* *Current Rev*	*Quarterly Growth*	*2023 Q3* *Current Rev*	*YoY Growth*
21,822.0	21,990.0	22,672.9	+1.5%	22,490.7	+3.1%

Source: U.S. Bureau of Economic Analysis, *National Economic Accounts*

Inflation

Consumer Price Index

2022-12	*2023-10*	*2023-11*	*2023-12* *Current*	*MoM*	*YoY*
298.9	307.6	307.9	308.8	+0.3%	+3.3%

Source: FRED Economic Data

Unemployment

2022-12	*2023-10*	*2023-11*	*2023-12* *Current*	*MoM*	*YoY*
3.5%	3.8%	3.7%	3.7%	0.0%	+5.7%

Source: FRED Economic Data

WTI Spot Oil Price

(Dollars per Barrel)

2022-12	*2023-10*	*2023-11*	*2023-12* *Current*	*MoM*	*YoY*
76.44	85.6	77.7	71.9	-7.5%	-6.0%

Source: US Energy Information Administration

YEARLY ECONOMIC/MARKET INDICATORS

GDP

(In current dollars)
Seasonally Adjusted at Annual Rates

2017	*2018*	*2019*	*2020*	*2021*	*2022*	*2023 (4 Qtr.)*
19,390.6	20,580.2	21,433.2	21,060.5	23,315.1	25,744.1	27,938.8

Source: U.S. Bureau of Economic Analysis, *National Economic Accounts*
Revisions are carried out about every 5 years.

Industrial Production Index

(2017=100)
Annual & Monthly Average

2017	*2018*	*2019*	*2020*	*2021*	*2022*	*2023 (12 Mo.)*
100	103.1	102.4	95.1	99.2	102.6	102.8

Source: Board of Governors of the Federal Reserve System, G 17 Seasonally adjusted.

Residential Buildings (Private)

(In billions of dollars)
Annual Historical Data & Monthly Average

2017	*2018*	*2019*	*2020*	*2021*	*2022*	*2023 (11 Mo.)*
514.7	544.0	515.5	691.0	775.3	852.1	896.7

Source: Bureau of Census, Manufacturing and Construction Division

Nonresidential Buildings Construction Put-in-Place (Private)

(In millions of dollars)
Annual Historical Data & Monthly Average

2017	*2018*	*2019*	*2020*	*2021*	*2022*	*2023 (11 Mo.)*
436.5	453.3	459.6	446.6	468.8	589.9	698.2

Source: Bureau of Census, Manufacturing and Construction Division

Highways and Streets (Public)

(In billions of dollars)
Annual Historical Data & Monthly Average

2017	*2018*	*2019*	*2020*	*2021*	*2022*	*2023 (11 Mo.)*
88.0	93.2	100.2	98.6	100.4	118.4	135.7

Source: Bureau of Census, Manufacturing and Construction Division

WTI Spot Oil Price

(Dollars per Barrel)

2017	*2018*	*2019*	*2020*	*2021*	*2022*	*2023 (12 Mo.)*
50.8	65.2	56.9	39.2	68.1	94.8	77.6

Source: US Energy Information Administration

COMBINE HARVESTERS SEE SOLID SALES GAINS TO CLOSE OUT 2023, WHILE U.S. TRACTOR SALES FALL

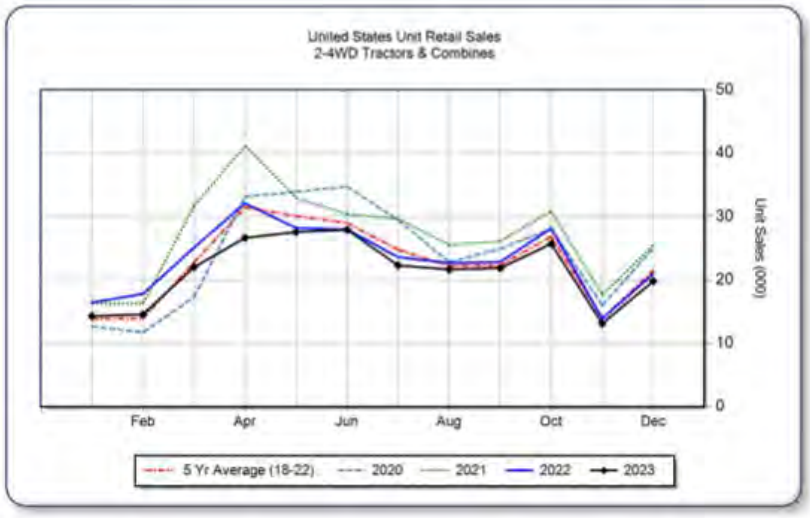
Combine harvester sales closed out the year ahead of 2022 levels, while almost all tractor segments saw declines in both the United States and Canada, according to the latest data from the Association of Equipment Manufacturers (AEM). Total U.S. farm tractor sales fell 5.1 percent in December compared to 2022, while year-to-date sales came in 8.7 percent lower than a year ago. However, 100+hp tractors grew 5.2 percent for the year and 3.6 percent in December, while combine harvesters finished 2023 with sales up 1.7 percent last month. The sub-40hp segment led losses for the year as a whole, falling 10.7 percent for calendar 2023 on the heels of a 5.8 percent drop in December.

For Canada, 4WD farm tractor sales jumped 64.9 percent in December and finished the year up 44.4 percent overall. Overall unit tractor sales finished 2023 down 14 percent for the month of December and 10.7 percent overall. All tractor segments other than 4WD units experienced double-digit declines in December, but combine harvesters did close out the year with YTD gains of 5.5 percent.

AEM
Association of Equipment Manufacturers

AEM United States Ag Tractor and Combine Report
December 2023

	December			YTD - December			Beginning Inventory
	2023	2022	%Chg	2023	2022	%Chg	Dec 2023
2WD Farm Tractors							
< 40 HP	9,959	10,568	-5.8	156,070	174,711	-10.7	92,987
40 < 100 HP	5,899	6,391	-7.7	61,881	68,095	-9.1	40,176
100+ HP	2,857	2,759	3.6	27,750	26,387	5.2	11,098
Total 2WD Farm Tractors	**18,715**	**19,718**	**-5.1**	**245,701**	**269,193**	**-8.7**	**144,261**
4WD Farm Tractors	**493**	**519**	**-5.0**	**4,564**	**3,466**	**31.7**	**686**
Total Farm Tractors	**19,208**	**20,237**	**-5.1**	**250,265**	**272,659**	**-8.2**	**144,947**
Self-Prop Combines	**610**	**730**	**-16.4**	**7,369**	**7,248**	**1.7**	**1,229**



Housing Starts Decline in December

Housing starts in the US declined 4.3% month-over-month to an annualized 1.46 million in December 2023, but above market forecasts of 1.426 million. It is the first decline in four months, following a downwardly revised 10.8% surge to 1.525 million in November. Single-family housing starts were down 8.6% to 1.027 million, the biggest fall since July 2022, while the rate for units in buildings with five units increased 7.5% to a five-month high of 417K. Starts fell in the Northeast (-16.9% to 108K), the South (-5.1% to 787K), and the Midwest (-8.8% to 187K) but rose in the West (4.7% to 378K).

Trade Deficit Narrows

The US trade gap narrowed to $63.2 billion in November 2023 from $64.5 billion in October and below forecasts of a $65 billion gap. It reflected a decrease in the goods deficit of $0.6 billion to $89.4 billion and an increase in the services surplus of $0.7 billion to $26.2 billion. Total exports were down 1.9% to $253.7 billion, prompted by a fall in sales of nonmonetary gold, crude oil, organic chemicals, autos and parts, and artwork and other collectibles while shipments increased for travel, transport and government goods and services. Meanwhile, total imports also fell 1.9% to $316.9 billion, due to purchases of cell phones and other household goods, pharmaceutical preparations, organic chemicals, drilling and oilfield equipment and transport while imports increased for crude oil and travel. The deficit decreased with China (by $2.4 billion to $21.5 billion) and the European Union (by $3.5 billion to $15.6 billion), but increased with Switzerland (by $2 billion to $2.3 billion).

Rhein Associates is a leader in North American commercial vehicle and off-highway powertrain forecasting, strategically located between Ann Arbor and Detroit, in Canton, MI. Rhein Associates is renowned for providing the industry with accurate, thorough and relevant databases, analysis and insight, by analysts that are involved and connected in the industry. Our data covers both on-road commercial vehicle as well as the off-highway, marine, industrial, agricultural and electrification sectors. With comprehensive and detailed Databases that include both historic and future applications, we service OEMs, suppliers, distributors, as well as financial and governmental institutions around the world.

Contact Us

Rhein Associates specializes in powertrain forecasting, however the knowledge and expertise goes much deeper. We are here to support the industry with analysis, forecasts, insight and thought leadership. Opportunity targeting, electrification scenario forecasts, and part number forecasts are just examples of topics our analyst team can support.

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