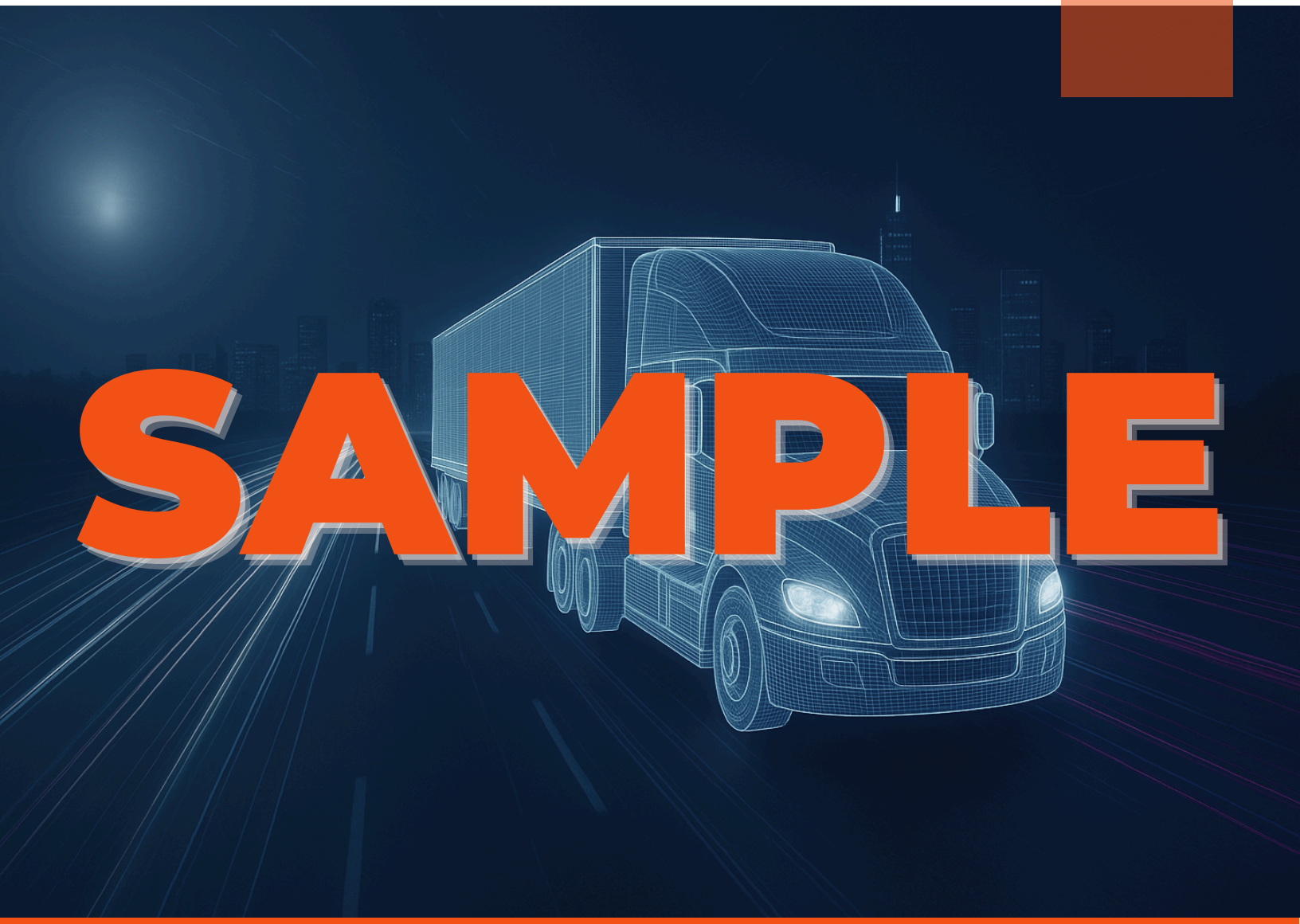
ACT Research



DRIVING AUTONOMY

The Commercial Vehicle Industry's Pursuit of Innovation, Safety, and Efficiency

ACT Research Co. || www.actresearch.net

ABOUT US

ACT Research has its finger on the pulse of the commercial vehicles industry like few others. As a trusted partner of LMC Automotive and the Chinese State Information Center, and contributor to the Blue Chip Economic Forecast and The Wall Street Journal Consensus Economic Forecast, we provide keen insights on benchmarks, market share analysis, short and long-term strategic and capacity planning based on our deep understanding of the commercial vehicle demand cycle. As a contributor to The Blue Chip Economic Indicators, ACT was awarded the 2019 Lawrence R. Klein Award for the most accurate economic forecast for 2015-2018.

ACT is recognized as the leading publisher of commercial vehicle (CV) industry data, market analysis, and forecasting services for the North American market. Our commitment to data quality and integrity; in-depth analysis; and timeliness have made our services the industry standards, as demonstrated by our award-winning forecasts and staff.

In short, we provide data and information that is critical to understanding the markets and their future. You depend on data. Depend on ACT Research.

ABOUT THIS STUDY

In 2018, ACT Research developed a groundbreaking, bottom-up total cost of ownership model used for forecasting commercial electric vehicle adoption. Since then, ACT has been the go-to source for segment-level TCO and total addressable market (TAM) insights and analysis for Classes 4-8 vehicles.

Building on the foundation of ACT's proprietary TCO modeling, we are now engaging in our second edition autonomous commercial vehicle research, the first effort concluding in 2022, with the objective of forecasting the adoption potential and use cases of autonomous commercial vehicles and the potential ramifications on over-the-road transportation.

Since ACT's landmark 2022 autonomous study, the pace of development, regulation, and commercialization has shifted. Companies across the CV ecosystem are reevaluating timelines, technology bets, and capital allocation. With dynamic change you need a forward-looking, structured view of what's real, what's noise, and where the market is truly headed.

This updated report delivers a fresh, validated, data-backed forecast built for OEMs, fleets, AV system developers, and suppliers navigating strategic planning for the next decade.

AUTONOMY REPORT SCOPE

DELIVERABLES

- **Analysis Report (PDF)** - A comprehensive written analysis that delivers clear context, expert commentary, and deep market insight across all major segments. Built on decades of ACT Research's leadership in commercial vehicle forecasting, this report covers emerging trends, key market drivers, infrastructure implications, competitive business models, early commercial corridors, and the timing risks that matter for strategic planning.

- **Forecast Tables (Excel)** - Intuitive, ready-to-use Excel tables that make it easy to access, filter, and apply ACT's latest forecasts. Designed for quick integration into your internal models, presentations, or planning workflows.

- **Graph Pack (PowerPoint)** - A complete PPTX slide deck featuring professionally designed charts and visualizations sourced directly from ACT. Ideal for executive briefings, board updates, or any presentation requiring clear, authoritative visuals.

- **Optional Analyst Consultation** - Looking to explore a topic further or ask questions about our work? You can schedule a session with ACT Research analysts for deeper discussion, clarification, or strategic guidance tailored to your organization's needs.

DELIVERY

Available in your ACT Research report portal on **November 26, 2025.**

INVESTMENT

$9,750

DRIVING AUTONOMY: THE COMMERCIAL VEHICLE INDUSTRY'S PURSUIT OF INNOVATION, SAFETY, AND EFFICIENY

Contents

EXECUTIVE SUMMARY

In 2022, ACT Research launched its inaugural study, *Driving Automation: Commercial Transportation's Pursuit of Level 4 Autonomy*, investigating the prospects for SAE Level 4 autonomous commercial vehicle (ACV) adoption. Since that multi-client study was published, we have continued our research and analysis efforts. With the reality of driver-out autonomous Class 8 tractors hauling loads along interstate freight corridors happening now, it is appropriate to publish this new study, *Driving Autonomy: The Commercial Vehicle Industry's Pursuit of Innovation, Safety, and Efficiency*.

As with the first study in 2022, the scope of this report is to provide a comprehensive look at the key factors influencing adoption of SAE Level 4 ACVs and the resultant adoption growth. *Driving Autonomy* is primarily focused on Class 8 tractor applications, with a more limited summary of other potential commercial vehicle applications. Our analysis has focused on the US market, because development activities for Class tractor applications are today centered on US freight corridor deployment. We expect this to remain the focus throughout the time frame of this study, with minimal impact from the Canadian market. All forecast data and analysis reflect the US CV market.

In today's market, SAE Level 4 ACVs are still, for the most part, in pilot testing stages. Current activity is focused on field testing and pilot runs taking place in the sunbelt states (primarily Texas), providing feedback for additional product development, while simultaneously helping to educate and inform stakeholders and the public about autonomous vehicles. The majority of AV systems providers focused on commercial vehicles have been established in the past eight to nine years, except for the few that found their starts earlier, but in adjacent vehicle markets. There are also a few that have only recently been established, though by industry veterans with experience in other AV companies. Legacy OEMs have been announcing partnerships with selected AV system providers since as early as 2019, providing legitimacy to the concept that autonomous trucks are more than just a speculative science project, but will have a reliable path to becoming a viable solution. Most global truck OEMs have launched commercial production of AV-ready Class 8 tractors, complete with all the required systems redundancy. Not all AV systems suppliers have opted to partner with an OEM, as some are adopting the strategy of being OEM-agnostic. In addition to the alignment of AV systems suppliers with OEMs, the past few years have seen a significant amount of activity between autonomous companies and commercial vehicle fleets and logistic suppliers.

While the bulk of the ACV market activity has been focused on freight hauling and long-haul Class 8 tractor-trailer combination applications, there are companies that have instead chosen to initially focus on straight truck, last-mile freight distribution and delivery, while others have focused on moving people in autonomous transit and shuttle bus applications, and others on off-highway and military applications. As a final subset, there are firms that have developed vehicles that completely eliminate the cab/human interface and operate as "pods" shuttling trailers within distribution centers. The majority of development and deployment plans are focused on long-haul Class 8 tractor applications and is the rationale behind ACT Research's decision to focus only on those applications for this study.

As we mentioned in our previous studies, the purchase of a commercial vehicle, in contrast to most passenger vehicle (PV) purchases, is not a lifestyle purchase for the buyer, but a business decision. This is true not only with for-profit businesses, but also nonprofits and government agencies that purchase vehicles based on total cost of ownership (TCO) financial considerations. Recognizing that most commercial vehicles are working in competitive situations, questions surrounding operating costs are fundamental for commercial buyers and are key to ACT's market-sizing methodology.

Our study's findings are that autonomous commercial vehicles can offer a better return on investment (ROI) than traditional driver-in vehicles, dependent on each application's unique duty cycle. SAE Level 4 ACVs are forecasted to see reasonable share adoption growth, particularly in the next decade as Operational Design Domain (ODD) constraints are eliminated and the technology develops over the time frame of this study. Key to this improved ROI is the ability to operate the ACV without any hours of service (HOS) restrictions, maximizing the utilization of a sizeable capital expenditure, which enables faster payback on that initial investment.

Before one can analyze adoption based on financial TCO/ROI analysis, the available market needs to be defined. The deployment feasibility of SAE Level 4 autonomous commercial vehicles depends on regulations that allow such operations, the specific ODD of the AV system which may or may not restrict operations to specific types of roadways, weather, or

other driving conditions, and understanding the types of hauling that can be accomplished without requiring a driver's support. A thorough review and discussion of regulations impacting ACVs can be found in the "Policy and Regulations" section of this report.

ACT has developed a very measured and methodical approach to analyzing these exogenous considerations and restraints, which has resulted in a stratified depiction of the elements that define the size of the total available market (TAM). As a result, the TAM changes over the time frame of the study, as regulations are forecasted to change, and the AV systems technology is also predicted to change, expanding the ODD. The "Total Available Market" section of this report discusses that methodology in detail. The underlying basis for defining the market has been developed using vehicle miles travelled (VMT) to size the various market layers. Those details, combined with the ACT Research used truck database (derived from more than a million transactions including vehicle ages and odometer readings), provide a basis for defining new truck sales, and from there we apply the adoption rates for ACVs.

Adoption rates are applied to the TAM, based on the financial analysis derived from our TCO models, detailed for each unique vehicle application. That analysis has been conducted using our detailed TCO models for freight hauling applications for hub-to-hub routes, as well as end-to-end routes for individual freight hauling Class 8 tractor applications.

The TCO models driving the study's conclusions are developed using a bottom-up approach by disaggregating commercial vehicle markets. From there, the model(s) consider AV system suite hardware and software component costs, vehicle redundancy costs that enable SAE Level 4, operational costs based on duty cycles, fuel costs, maintenance costs, insurance, supporting infrastructure, and more. The TCO models generate two key financial measures: payback period and total lifetime cost savings, comparing ACVs (SAE Level 4) against incumbent traditional vehicles operated by human drivers. The financial analysis is based on analyzing incremental costs for the autonomous systems and vehicle redundancy requirements—utilizing a diesel powertrain—coupled with resultant operating margins. We do recognize that in the later years of this study—based on the results of ACT's *OUTLOOK PLUS* quarterly analysis of decarbonization solutions—battery-electric powertrains could prove to be a viable alternative to diesel in many use cases, even for Class 8 tractors. To keep a simple apples-to-apples comparison, we have opted to analyze the TCO using a diesel powertrain for a consistent approach.

ACT Research has developed a proprietary algorithm that converts these financial metrics into share points to derive adoption rates. The costs associated with ACVs will fall over time, thanks to rising volumes and continuous technological improvements, while incumbent driver-in vehicle markets will continue to face driver recruiting challenges that will be exacerbated through the forecast period by low population growth. The impact of these two dynamics results in rising market shares for autonomous vehicles post 2030.

Infrastructure to support ACVs, and particularly hub-to-hub operations, is reviewed in the "Infrastructure Considerations" section of this report. Our study findings show that the concept of transfer hubs is still in the early planning stages, with some uncertainty as to ownership of such transfer hubs, and whether they will be public or private facilities, or some mix. There has already been some activity with real estate developers acquiring properties on the outskirts of major freight markets, as they bet on an autonomous future in that market niche.

A driving force behind the concept of adopting autonomous technology to commercial vehicles has been both inherent safety benefits and the decline in available drivers to fulfill trucking needs, especially long-haul routes. The industry will see a shift from long-haul to local driving jobs as well as the growth of new jobs to support autonomous freight. While there will be contraction in long-haul truck driving jobs, virtually all the reductions will be through attrition and retirements. The "Driver Impact" section of this report includes a comprehensive review of driver impact and considerations.

A study on ACV adoption would not be complete without research on and discussion of pertinent industry standards governing AVs. The section "Safety Standards" encompasses a review of the ACV safety standards containing a thorough review of the various UL, ISO, ANSI, SAE, and UNECE standards that ensure safety and reliability of autonomous commercial vehicles.

Autonomous driving systems for CVs are still in the piloting stages of implementation, and for the foreseeable future, there will be ongoing development

and improvement of the systems. 2025 has seen a considerable uptick in activity, with nearly every major OEM and AV system developer focused on the truck market announcing significant advancements in their autonomous commercial vehicle programs. In January of this year, SAE Level 4 trucks began operating in the Permian Basin, servicing Texas oil field operations. The Texas Triangle, covering freight routes between Dallas-Fort Worth, Houston, and San Antonio along I-10, I-35, and I-45, has become the center of activity, with SAE Level 4 Class 8 tractors pulling full loads, proving the technology works. These are significant milestones and confirm ACT Research's findings in 2022's *Driving Automation*, pegging the commercial launch of SAE Level 4 (admittedly very limited) to occur in 2025. While yes, SAE Level 4 ACVs are now operating in Texas, the ramp to greater volume adoption will not be realized until post 2030. Industry participants from all aspects—OEMs, AV service providers, fleets, and logistics providers—have indicated that the deployment of SAE Level 4 commercial vehicles will be achieved through a very measured and careful approach.

When we published *Driving Automation* in 2022, we envisioned developments and activities in this technology would justify an updated analysis and report sooner than the three years between then and now. Our ongoing analysis indicated otherwise, and rather than hold steadfast to some date on the calendar, we opted to publish our analysis and updated forecast at this time. We look forward to continuing our analytical work on ACV adoption and are excited to see the progression of this technology in our industry over the coming years. While years ago, a driver-out Class 8 tractor might have seemed to be an impossible dream, the innovators in our industry are proving that dreams can become reality.

Driving Autonomy – SAE Level 4 Class 8 Tractors

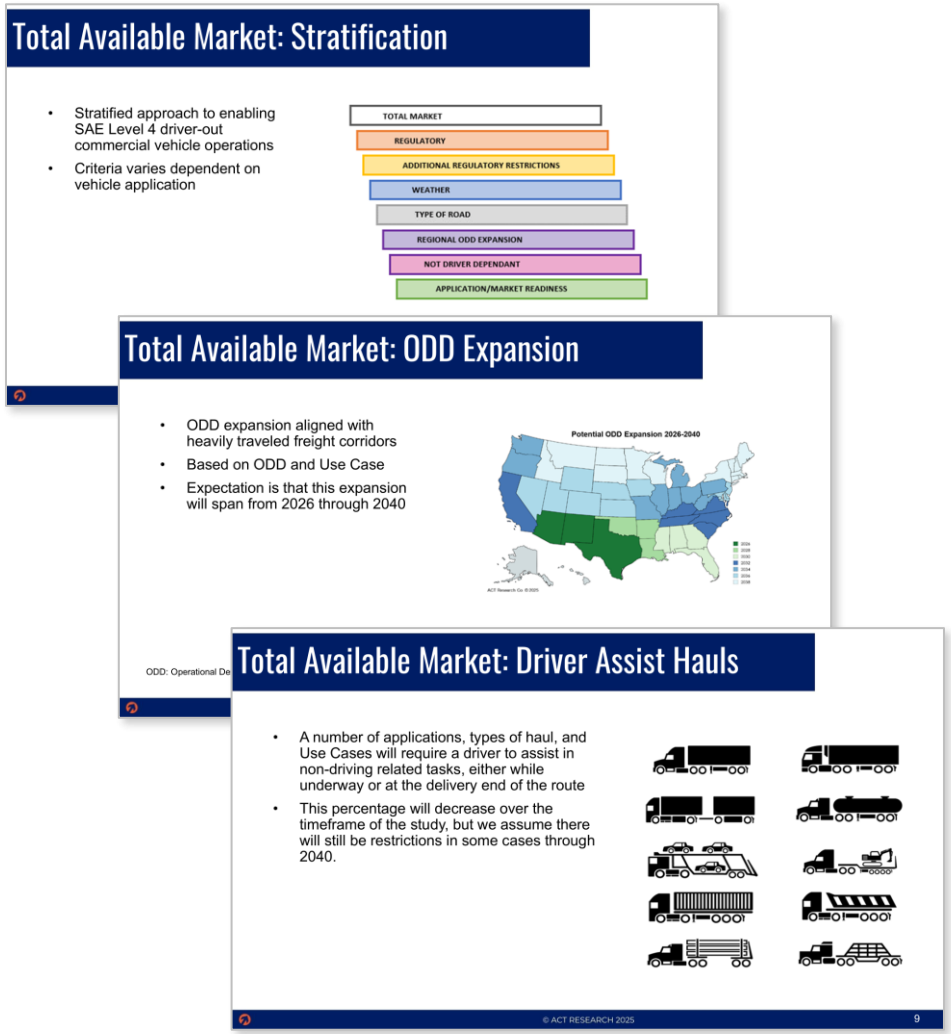
ACT RESEARCH STUDY FINDINGS

Increased Vehicle Utilization

- ✓ ROI
- ✓ Value per Mile
- ✓ Greater Shipping Lane Flexibility

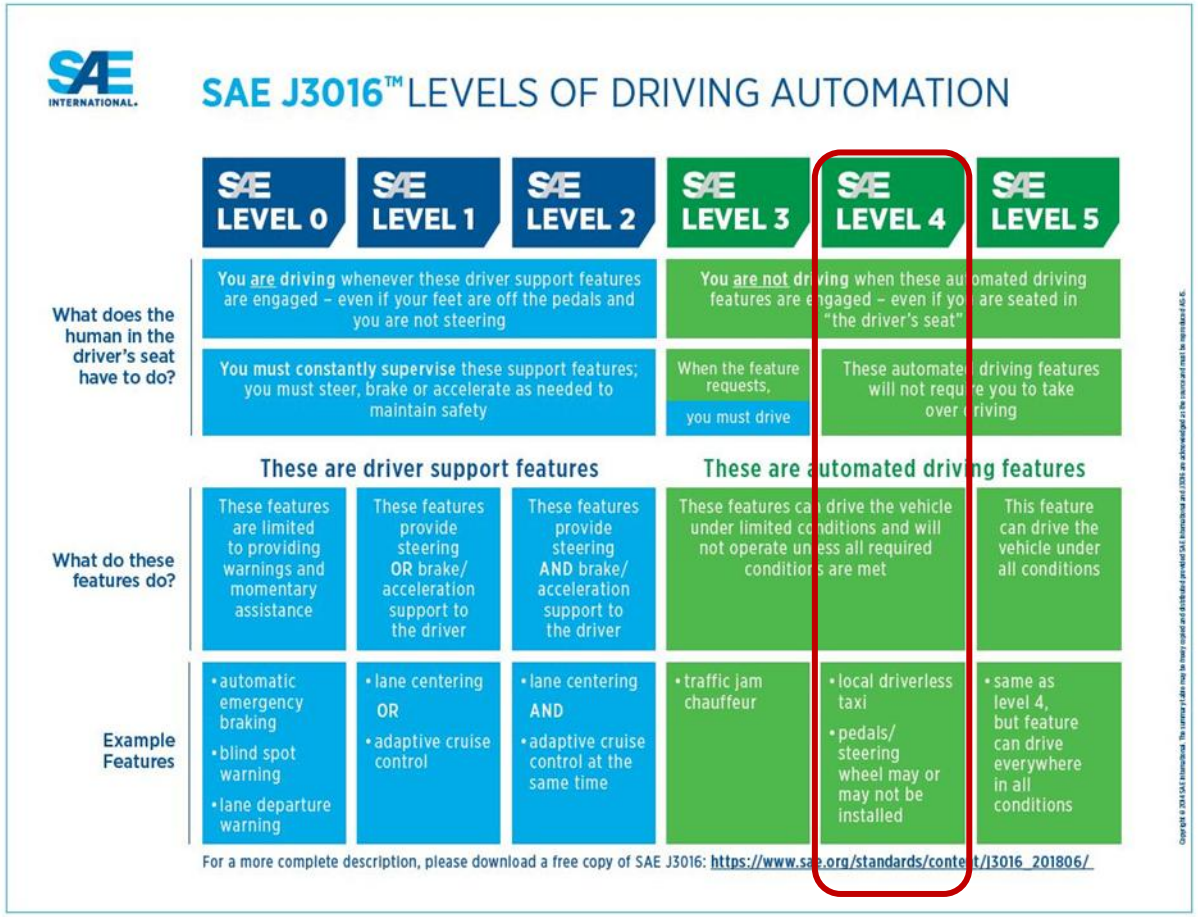
Slow Measured Adoption Curve

- ✓ Stratified Market Availability
- ✓ Hub-to-Hub Deployment
- ✓ Major Interstate Freight Corridors
- ✓ Launch in Sunbelt States



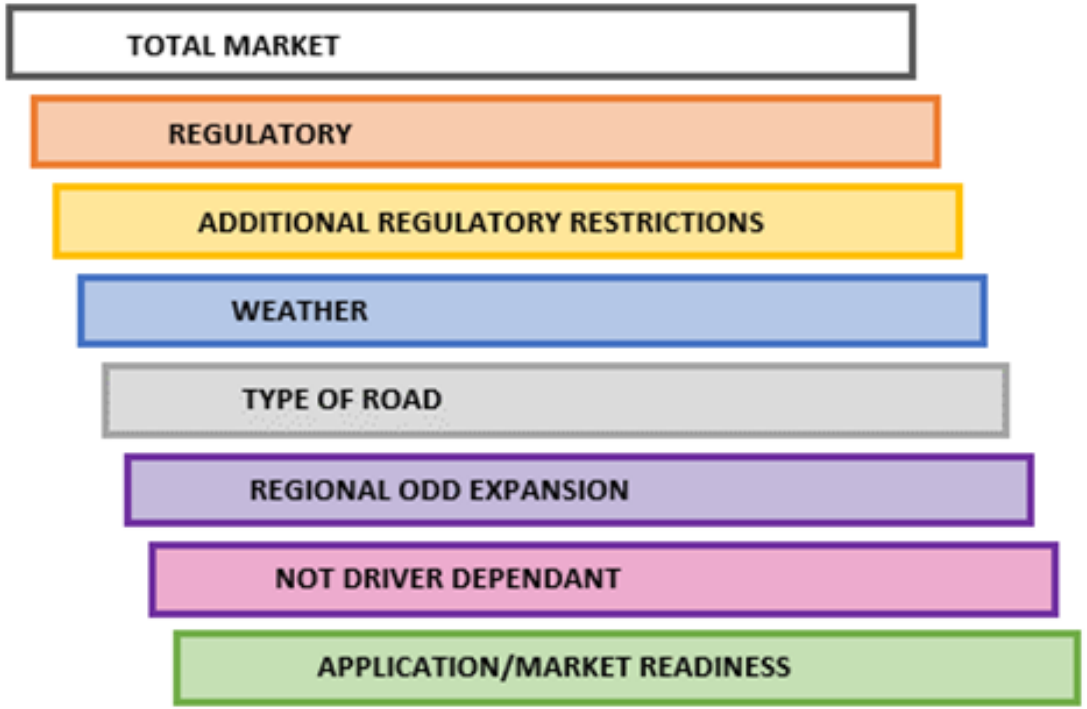
Autonomous Commercial Vehicle: SAE Level 4

- SAE Level 4 = ***High Driving Automation***
- *Dynamic Driving Task* (DDT) = functions required to operate a vehicle in on-road traffic
- *Operational Design Domain* (ODD) = specific conditions under which a driving automation system is designed to function
- *Automated Driving System* (ADS) = HW & SW capable of performing the entire DDT



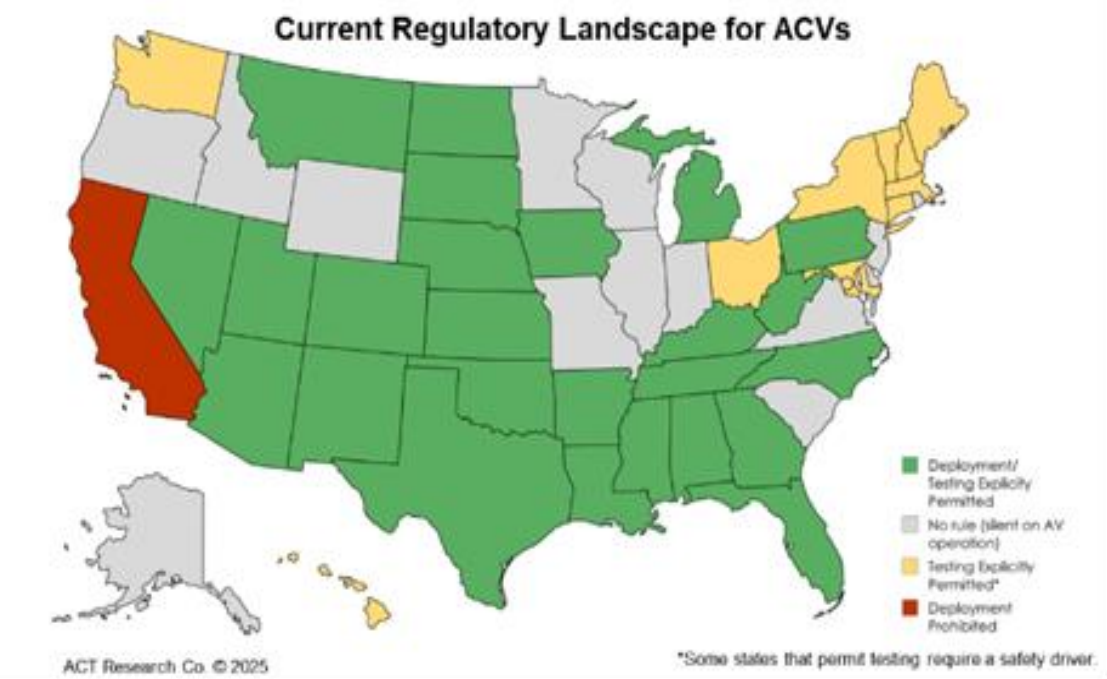
Total Available Market: Stratification

- Stratified approach to enabling SAE Level 4 driver-out commercial vehicle operations
- Criteria varies dependent on vehicle application



Total Available Market: Regulatory

- Level 4 Driver-out Regulations already exist today at the State level
- TAM developed based on assumptions of ACV regulation expansion 2024 - 2030



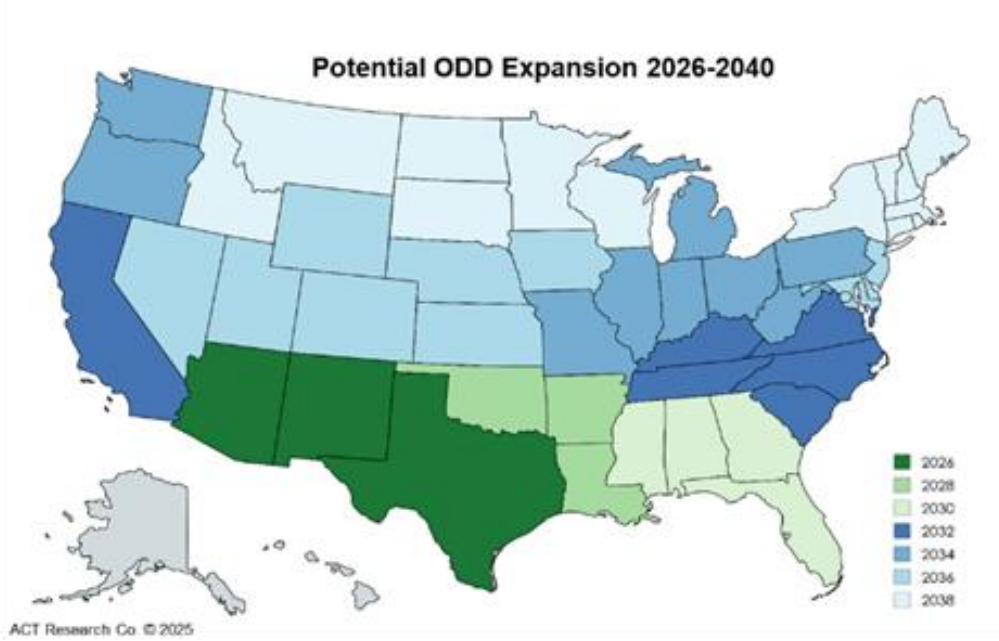
Total Available Market: Weather

- Initial restrictions based on AV Systems ODD / Use Case capabilities
- Later year restrictions based on requirements for human assistance, e.g. tire chains …

Source: NOAA

Total Available Market: ODD Expansion

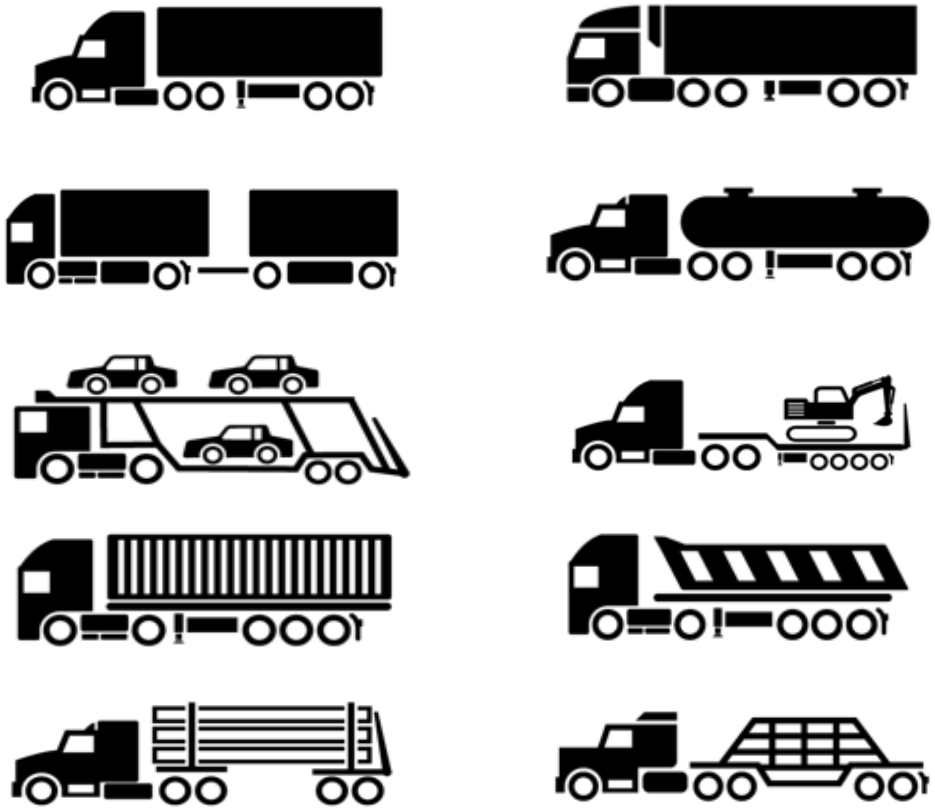
- ODD expansion aligned with heavily traveled freight corridors
- Based on ODD and Use Case
- Expectation is that this expansion will span from 2026 through 2040



ODD: Operational Design Domain

Total Available Market: Driver Assist Hauls

- A number of applications, types of haul, and Use Cases will require a driver to assist in non-driving related tasks, either while underway or at the delivery end of the route
- This percentage will decrease over the timeframe of the study, but we assume there will still be restrictions in some cases through 2040.



ACV Adoption Conclusions

- Class 8 long-haul, hub-to-hub deployment will be the predominant application for SAE Level 4 ACVs through 2040
- Deployment will see slow, measured launch, with a very flat adoption curve through to 2035
- Traditional driver-in Class 8 tractors will remain as mainstay operations for many applications - contraction of jobs will be through attrition and retirements as the work force ages
- Autonomy will enable job growth in supporting “next-to-the-cab” type of positions
- SAE Level 4 ACVs are operating today in Texas, with expansion in sun-belt states planned over the next few years