

Our Future With Autonomous Trucking

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Autonomous Trucking in North Dakota: Prospects and Challenges

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robots
carrying people



robots
in construction/mining



Driverless
The Big
Picture

robots
in the warehouse



robots
moving freight



robots
helping farmers



Fleet Operations

Automated Driving — Fleets First: RoboDelivery, RoboTaxis, RoboTrucks.



- Operations area selected for best fit with tech capability.
- Cost pressure is much less than retail model; it's all about Return on Investment!
- Hands-on, skilled staff provides software upgrades, system safety certification, maintenance, etc.

RoboTaxi

Rapidly increasing numbers of people are accessing transportation services driven by autonomy.



CRUISE



WAYMO



ZOOX

People-Carrying Autonomous Fleet Services

RoboTaxis



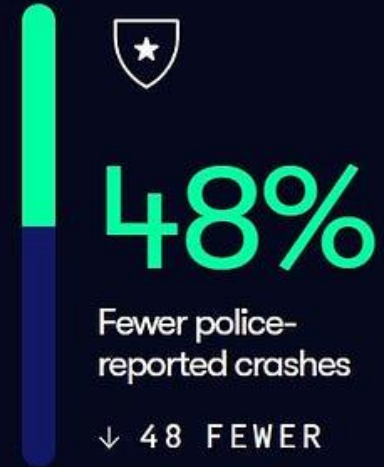
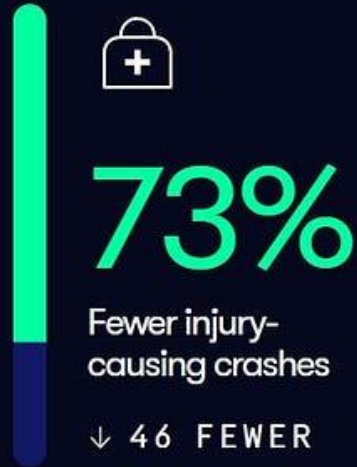
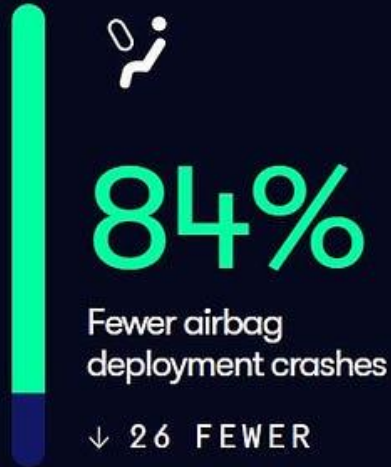
WAYMO

- Now conducting 100,000 paid trips per week in Austin, Los Angeles, Phoenix, San Francisco, Silicon Valley
- 22M “rider only miles” so far
- Adding two million miles per month
- Now adding highway operations, leveraging prior work in trucking



2024 Waymo Safety Performance Dashboard

Compared to a human driver over the same 22M mile distance in Phoenix and San Francisco, the Waymo Driver had →



Phoenix

16
Fewer airbag deployment crashes

19
Fewer injury-causing crashes

29
Fewer police-reported crashes

San Francisco

10
Fewer airbag deployment crashes

27
Fewer injury-causing crashes

19
Fewer police-reported crashes

Driverless Trucks

Wherever wheeled vehicles are “doing work,”
there’s a business case to make for autonomy.

Demand for driverless trucks is driven by:

- a continuing driver shortage
- energy efficiency
- shorter transport duration times
- increased safety
- lower costs of operations

Four Trucking Domains

Long Haul



Logistics Yard



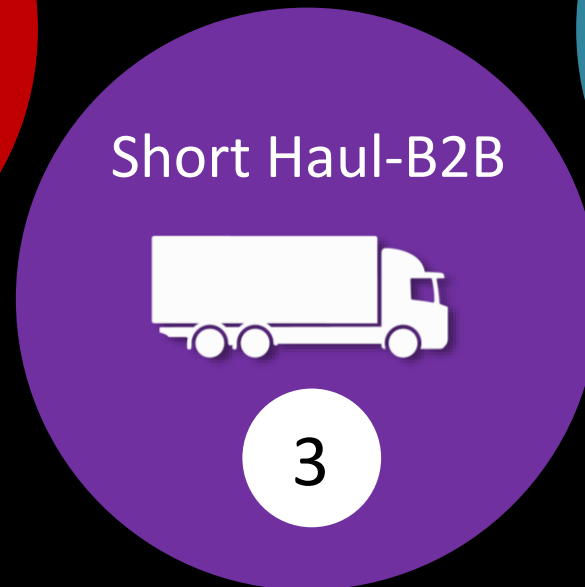
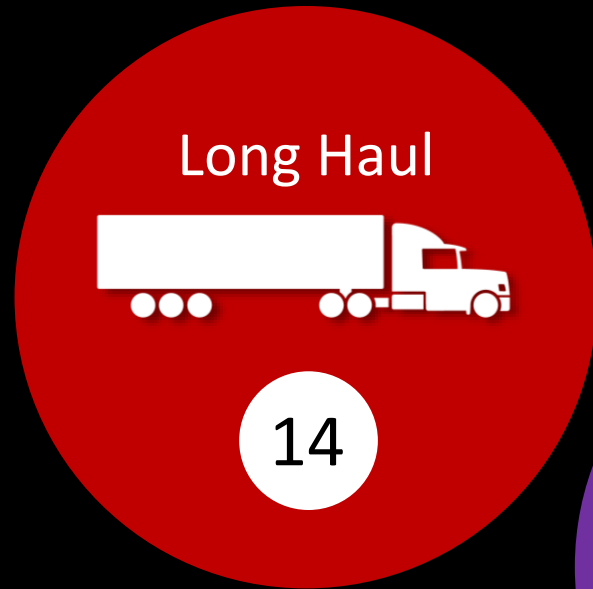
Short Haul-B2B



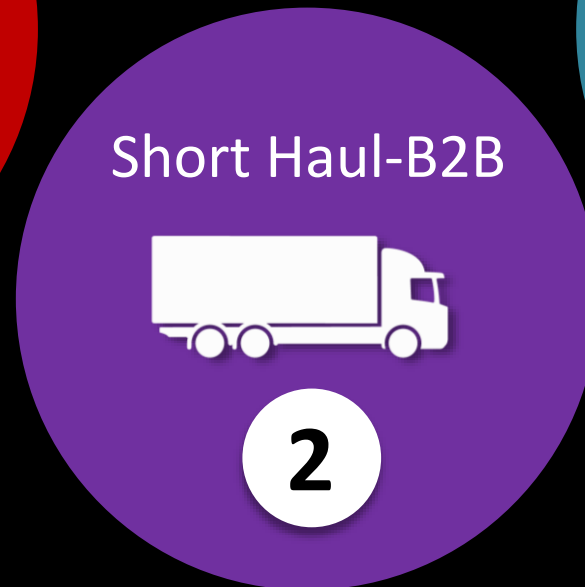
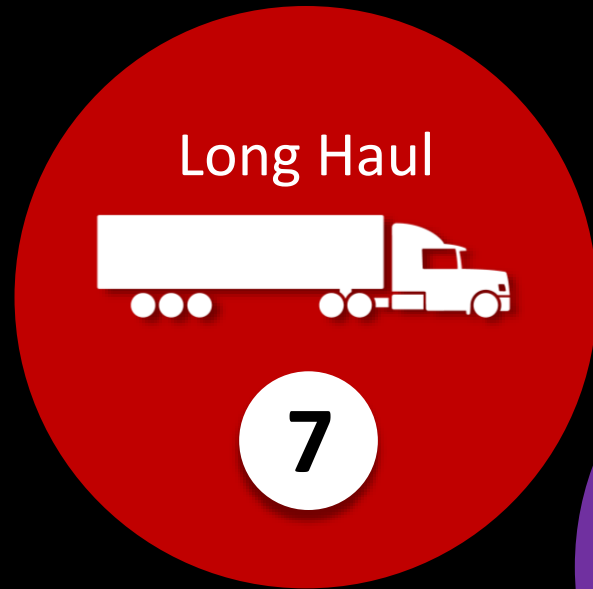
Industrial Ops



Number of Automated Driving System (ADS) Developers Globally



Number of Automated Driving System (ADS) Developers USA



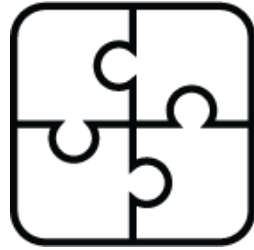
Automated Trucking — Key Factors



Operating
Environment



Vehicle Type



Partnerships



Revenue
Model



Regulations



Timing



Long Haul Driverless
North America

AV Trucking – U.S. Players

7

Long Haul

  BOT.AUTO

  plus.ai

 STACK  TORC

 waabi

2

Short Haul

 E/NRIDE

 Gatik

3

Logistics Yard

 FORTERRA

 ISEE

 Outrider

Truck Manufacturer Partnerships Are Key For Commercial Rollout

Aurora

V O L V O PACCAR

Plus

TRATON IVECO

TORC

DAIMLER TRUCKS

Gatik

ISUZU

FORTERRA

Kalmar

Role Of The Truck Manufacturer

- OEM partnership essential for scaling!
- Redundant systems key to the safety case must be factory installed.
- **All four** of the major truck brands in the U.S. have partnered with a driverless truck provider.

Long-Haul AV Trucking – Kodiak

- Providing transport services directly to trucking fleets
- Commercial Phase:
 - Launching on-road driverless operations early 2025
 - On-road customers include CEVA Logistics, IKEA, Maersk, Tyson Foods, US Xpress, Werner
 - Off-road customers include Atlas Sands, US Department of Defense

Kodiak continues to scale its operations in Texas and across the South.

Loads Delivered

6,000+

Loads per Week

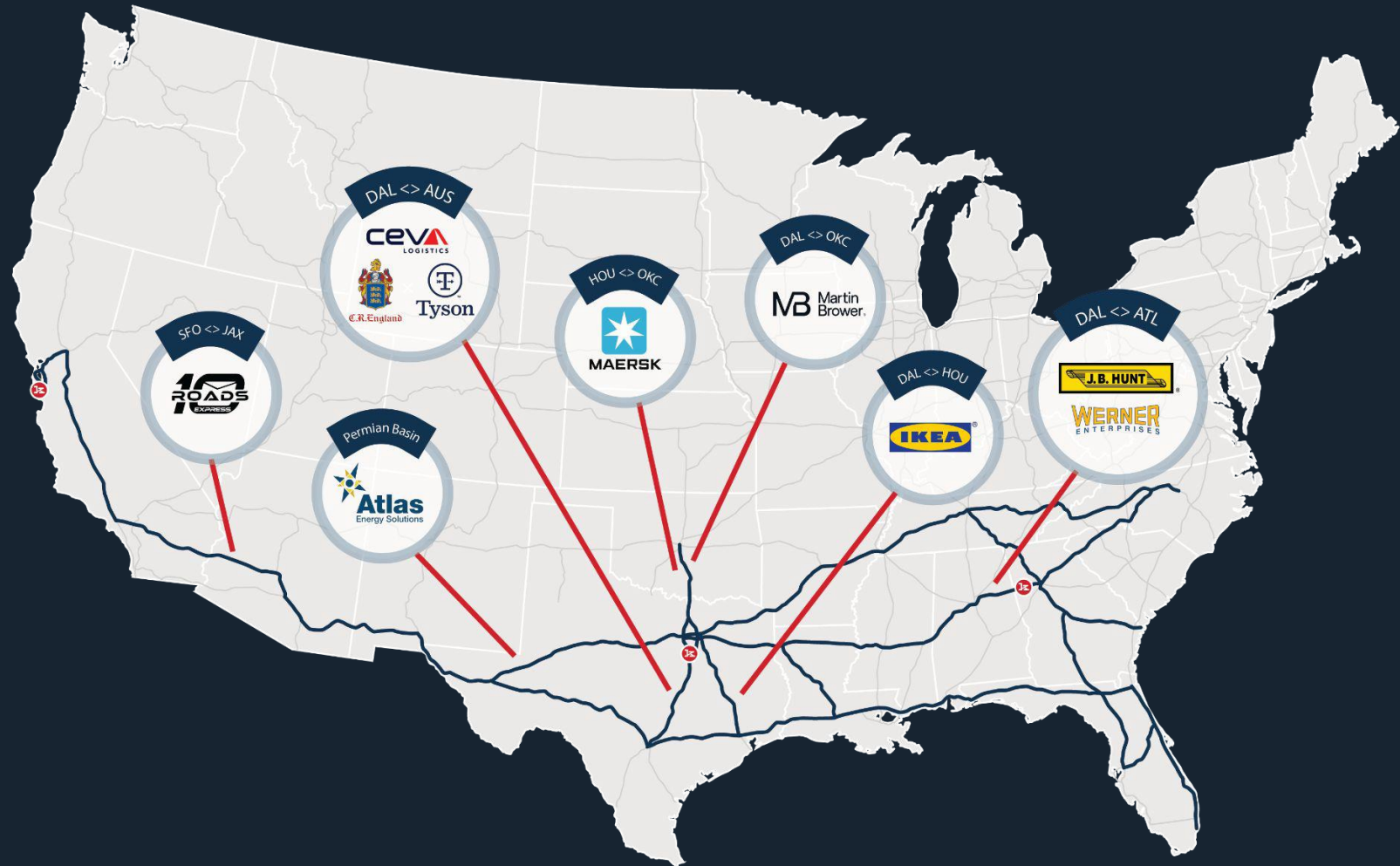
50+

Miles Driven

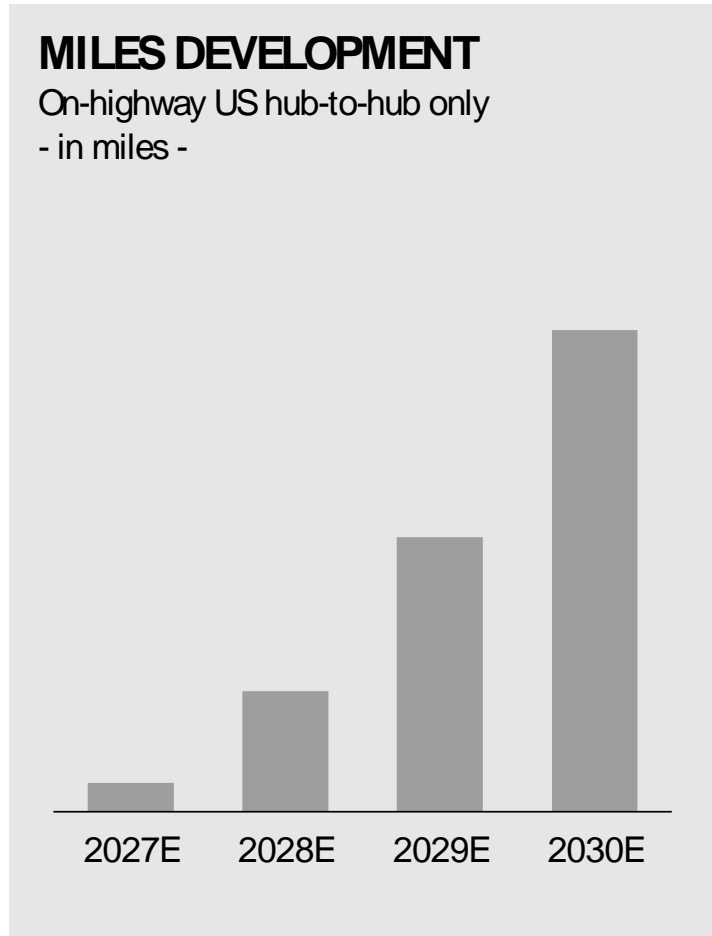
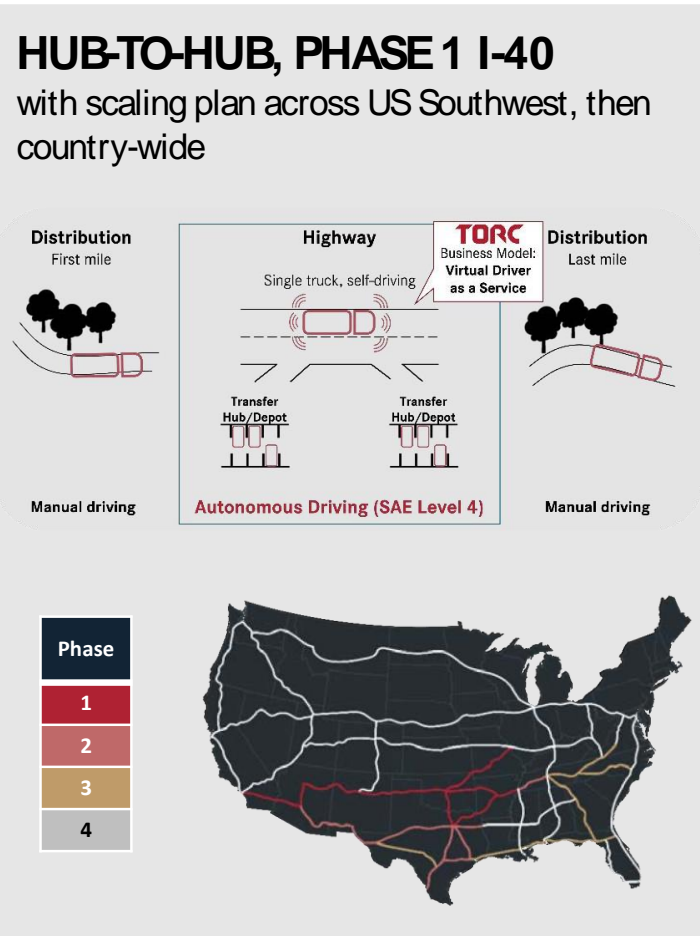
3.5M+

Operational Miles

19K



Long-Haul AV Trucking – Torc Robotics (majority owned by Daimler Trucks)



2027
MARKET ENTRY

>3 billion €
REVENUE POTENTIAL IN 2030

>1 billion €
EBIT POTENTIAL IN 2030

Long-Haul AV Trucking – Aurora

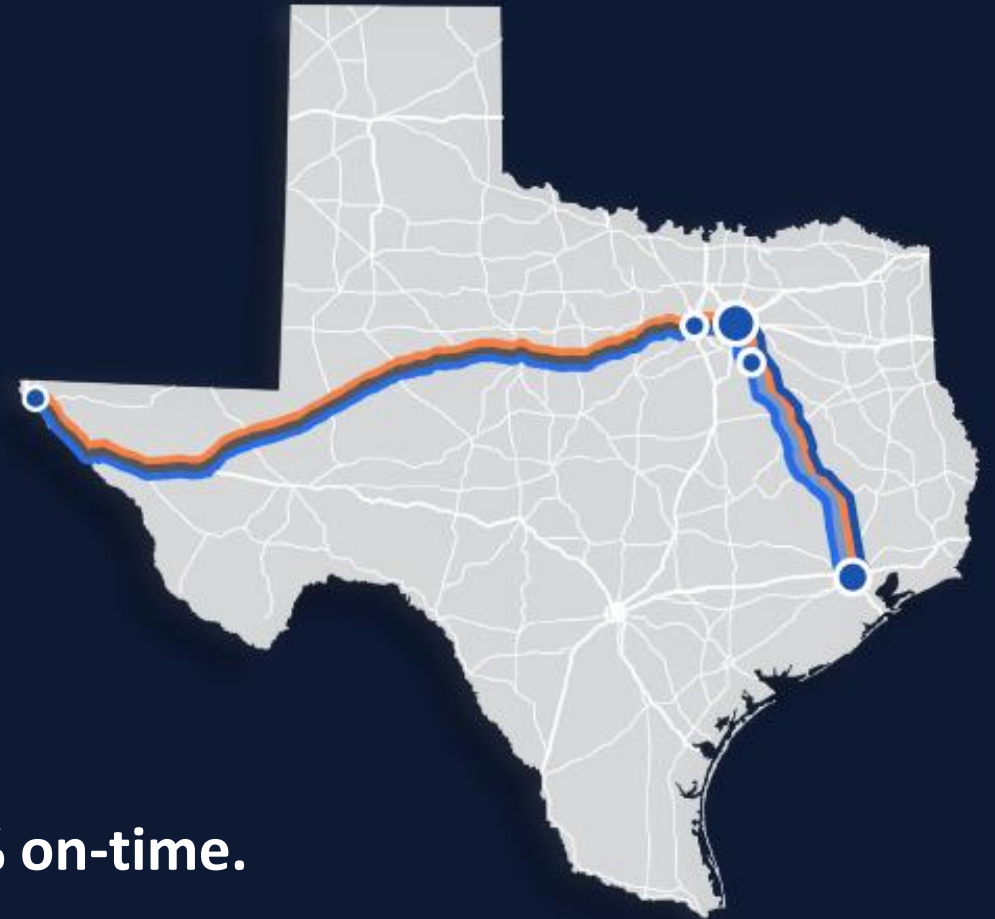
Public Reporting Brings Wealth of Information:

- Delivered 6785 loads across 1.8M miles, nearly 100% on time
- On-road Autonomy Performance Indicator: 98%
 - tracks performance in successfully operating in a commercially-representative setting
- Autonomy Readiness Indicator: 95%
 - reflects progress toward achieving “Aurora Driver Ready” milestone
- Full commercialization (“driverless”) with fleet customers by year end.

We are autonomously hauling freight for our pilot customers on two lanes in Texas

AURORA

Through our pilots and customer collaborations, we are scaling and informing our operations



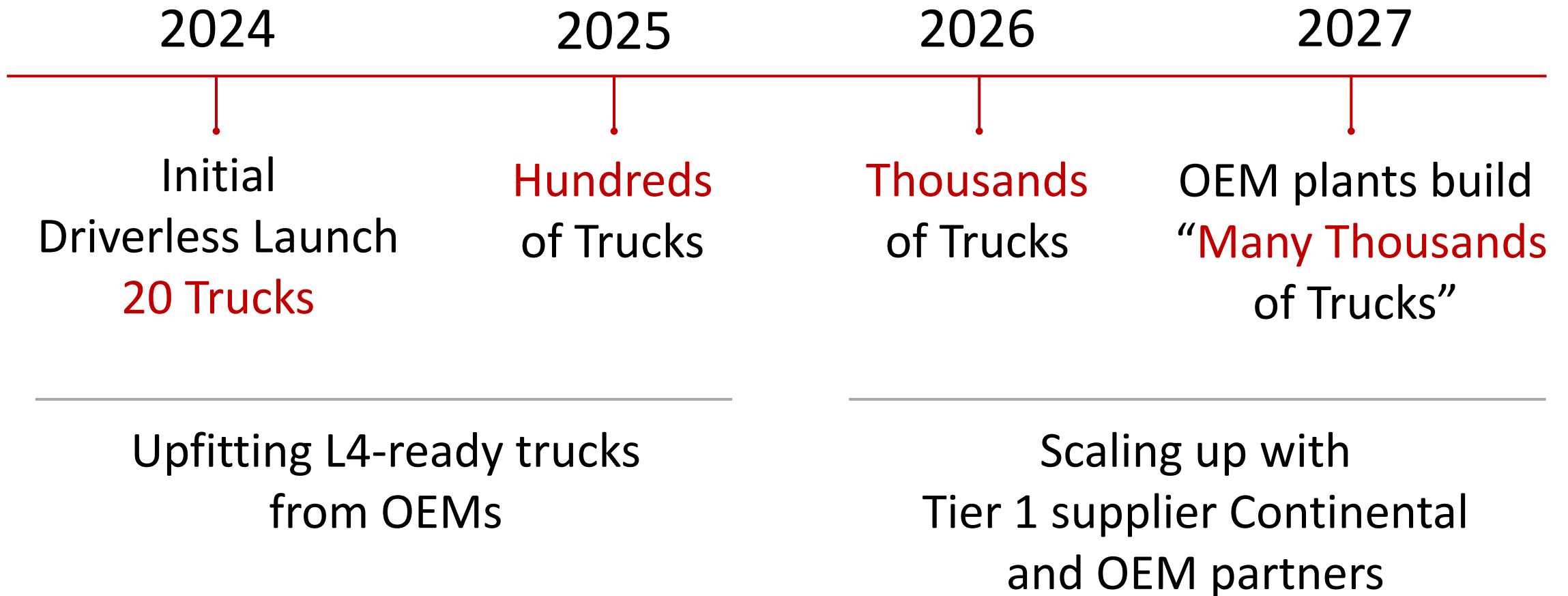
Delivering 4000 loads across 1M miles nearly 100% on-time.

We plan to launch Aurora Horizon in Texas and then initially expand through the interstate highway system across the Sun Belt before moving northwards





A Look At Driverless Launch – Aurora





Long Haul Driverless
Upstarts

Long-Haul AV Trucking – Room for Newcomers

Stack AV

- AI-centric development
- Funded by Softbank (\$1B)
- Founders of Stack AV earlier founded Argo.ai robotaxi
- Development in “virtual space” ongoing

Long-Haul AV Trucking – Room for Newcomers

Waabi

- AI-centric development
- Uber Freight partnership running on routes between Dallas and Houston
- Commercial operations will expand “quickly” starting in 2025
- Transportation-as-a-Service TAAS business model
- On-road testing underway in Texas

Long-Haul AV Trucking – Room for Newcomers

Bot.Auto

- New entrant for 2024
- \$20M initial funding round
- “Leveraging cutting-edge AI technology”
- Transportation-as-a-Service business model
- Now starting on-road testing in Texas



Long Haul Driverless
The Supplier Approach

The New (Old) Paradigm—Supplier Approach



- Plus production-ready system being adopted by leading truck OEMs
 - 2021 | Iveco production partnership
 - 2024 | Traton production partnership
- 2024 | Hyundai Motor Company collaboration in testing L4 fuel cell truck

The New (Old) Paradigm—Supplier Approach



- Rather than fielding a trucking fleet directly, **tech product flows to supplier/OEM.**

Accessing autonomy through the OEM marks
further maturing of the space.

The supplier model will increasingly become dominant across tech developers.



Short Haul—B2B

Gatik

- \$250B Short-Haul Logistics market focus
- Customers include:
 - Walmart
 - Kroger
 - Tyson Foods
 - Pitney Bowes
 - Georgia-Pacific
- Locations across North America include Texas, Arkansas and Ontario
- Operating on repetitive, predictable routes (surface streets and highways)
- 65 trucks in commercial operation today
- “Freight-only” operations to launch in coming months





Gatik
WE OWN THE MIDDLE MILE

Gatik

GOODYEAR



Logistics Yard

Yard Operations for Trailer Shuttling – Several Offerors in the U.S.

- Forterra
 - Commercial driverless operations at Detroit intermodal hub
- ISEE
 - Commercial deployment underway at customer distribution center.
- Outrider
 - Commercial deployments underway at customer distribution centers







Industrial Ops

Industrial Operations – Forest Products Innovations (FPI)



- FPI is a research center funded by the Canadian Forestry Industry
- FPI contracted with **Forterra** to develop a truck platooning system for timber hauling
- Advanced field testing is underway
- FPI targeting pre-commercial operations in 2025





Industrial Operations – Minn-Dak Farmer's Cooperative



- Since 2022, leader-follower truck platooning in North Dakota hauling harvested beets to processing plant
- Tech supplied by **Kratos Defense**

Industrial Operations – Mineral Resources

- Mining operator Mineral Resources is running autonomous road trains in Australia, provided by Hexagon
- Multiple **driverless road-trains** platoon behind a human-driven leader road-train
- Mineral Resources plans to field more than 120 automated trucks



Industrial Operations – Kodiak



- Driverless in West Texas, Permian Basin
 - Hauling frac sand for Atlas Energy Solutions
 - Private, compacted dirt industrial roads
 - First driverless delivery: May 2024

Industrial Operations – Brønnøy Kalk Mine



- Brønnøy Kalk Mine in Norway running driverless trucks developed by **Volvo Autonomous Solutions**

Public-Private Collaboration

DriveOhio




















TRUCK
AUTOMATION
CORRIDOR



I-70 Truck Automation Corridor

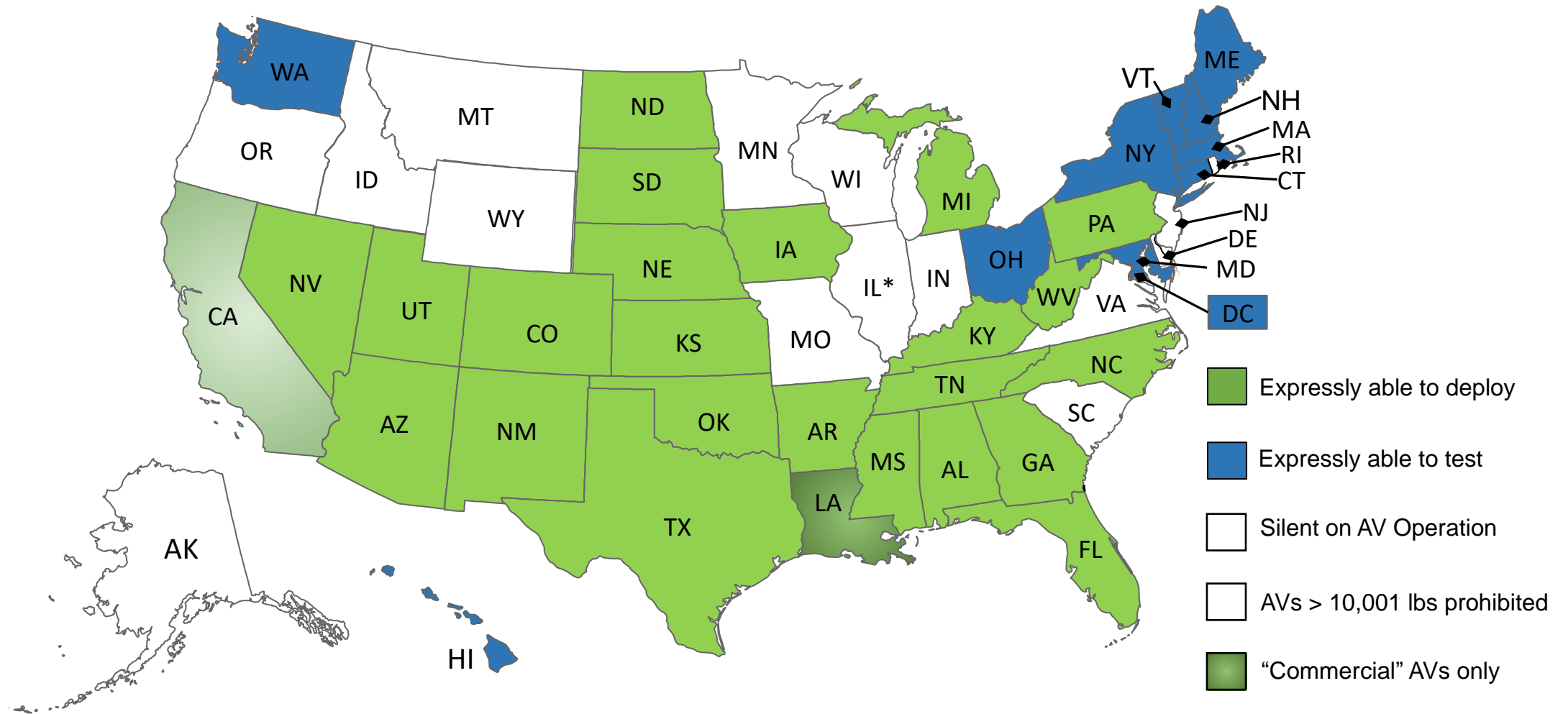
- USDOT ATCMTD Grant to Drive Ohio / Indiana DOT
- Objectives
 - Advance truck automation in the Midwest
 - Assess / prepare infrastructure
 - What is an “Automation Ready” roadway?
- Commercial Trucking Operations: L1 Platooning, L2, L4
 - L1 Platooning will go live early 2025
 - **RFP for L2, L4 Operations soon to be released; \$2M funding**

Timeline

ANNOUNCED DEPLOYMENTS	2022	2023	2024	2025	2026	2027
 Long Haul				 		
 Short Haul						
 Yard Ops			 			
 Industrial		 				

What To Keep An Eye On

U.S. State AV Laws & Regulations



*Illinois has an executive order in place that has not been implemented

What To Keep An Eye On

- **Regulatory — U.S.**
 - 25 states allow operations of fully automated trucks
 - **California** has not allowed truck automation since initially allowing automated cars. New proposed rulemaking aims to allow trucks.
 - U.S. situation is **fractured** but works (for now).
 - Industry seeks USDOT NPRM to formally allow automated trucking and creating an **AV Federal Safety Framework**.
 - U.S. **labor unions** pushing state legislators to require “drivers” in driverless trucks. Not successful yet, remains a threat.

What To Keep An Eye On

- **Proof Points**
 - Evolution of safety performance metrics
- **Capability / Competitive Discriminators**
 - Operations across a wide range of weather conditions
 - Long Haul operations on both highways and streets so that cargo can be delivered to the final destination

What To Keep An Eye On

- **Business Models — Truck**
 - What's the value of **highly advanced driver assistance systems** which allow the driver to be a supervisor while the truck does the the basic on-highway driving?
 - Channels to market: how long will it take for AV trucks to be available via traditional sales channels (OEM dealerships)?
 - How much **choice** will freight carriers have when purchasing an autonomy-ready truck later in this decade? Will truck OEMs offer multiple ADS products in their catalog?

What To Keep An Eye On

- **Public Acceptance**
 - How will robotaxi deployments and truck AV deployments interplay in terms of the regulatory environment and public acceptance?
 - Will the **freight shipper voice** become more prominent in political/regulatory issues and addressing public acceptance?



What To Keep An Eye On

- **Public-Private Collaboration — Does Infrastructure Have A Role?**
 - Safety performance of an autonomous truck must rely completely on on-board equipment.
 - Is there a role for roadside-based sensing as well to enhance performance?
 - For infrastructure-sourced data, is there a **public or private business case?**

Conclusion

- Wherever freight is being moved, companies are developing and fielding automated driving solutions.
- Driverless trucks are on the cusp of meaningful deployment.
- Freight-hauling customers are lining up.
- Beyond “test and development” – it’s now about fulfilling market needs.

- On both streets and highways, companies are set to launch scale-able fully driverless trucking services in public traffic in the coming months.
- “Freight-Only” operations mark a significant turning point in truck autonomy.
- ***IT’S GETTING REAL***

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