

Torc Robotics: Driving the Future of Freight with Autonomous Commercial Motor Vehicles

Presentation for the SE Florida Model Users Group

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November 22, 2024



DRIVING THE FUTURE OF FREIGHT |

TORC



Agenda

About Torc

Technology Overview

Why Autonomous Trucking

Policy Landscape and Looking Ahead

TORC

About Torc

FREIGHTLINER

TORC



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ABOUT TORC

Torc Robotics (**Torc**) is driving the future of freight by developing autonomous trucking solutions. Based in Blacksburg, VA.

WHAT WE DO

Commercializing Level 4 **autonomous** technologies for long-haul trucking applications

OUR TIMELINE

Safety dictates our timeline. For autonomous trucks to be widely adopted, they must be safe, economically viable for major fleets, and produced and maintained at scale. Torc is looking towards scalable commercialization in 2027.

DRIVING THE FUTURE OF FREIGHT | TORC



TORC AND DAIMLER TRUCK

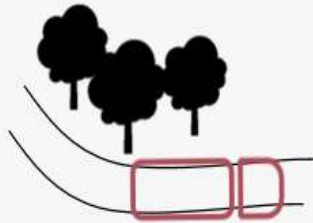
Daimler is a leading manufacturer of trucks in North America

Daimler is developing a chassis purpose-built for autonomous system integration.

Torc is building the autonomous driving system and defining system requirements.

Hub to Hub Model

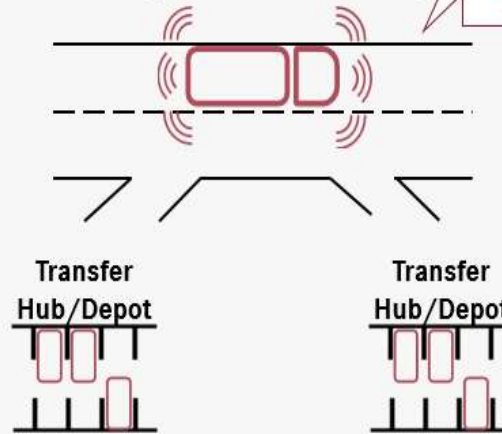
Distribution
First mile



Manual driving

Highway

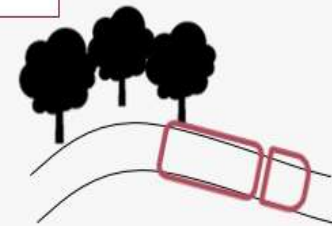
Single truck, self-driving



Autonomous Driving (SAE Level 4)

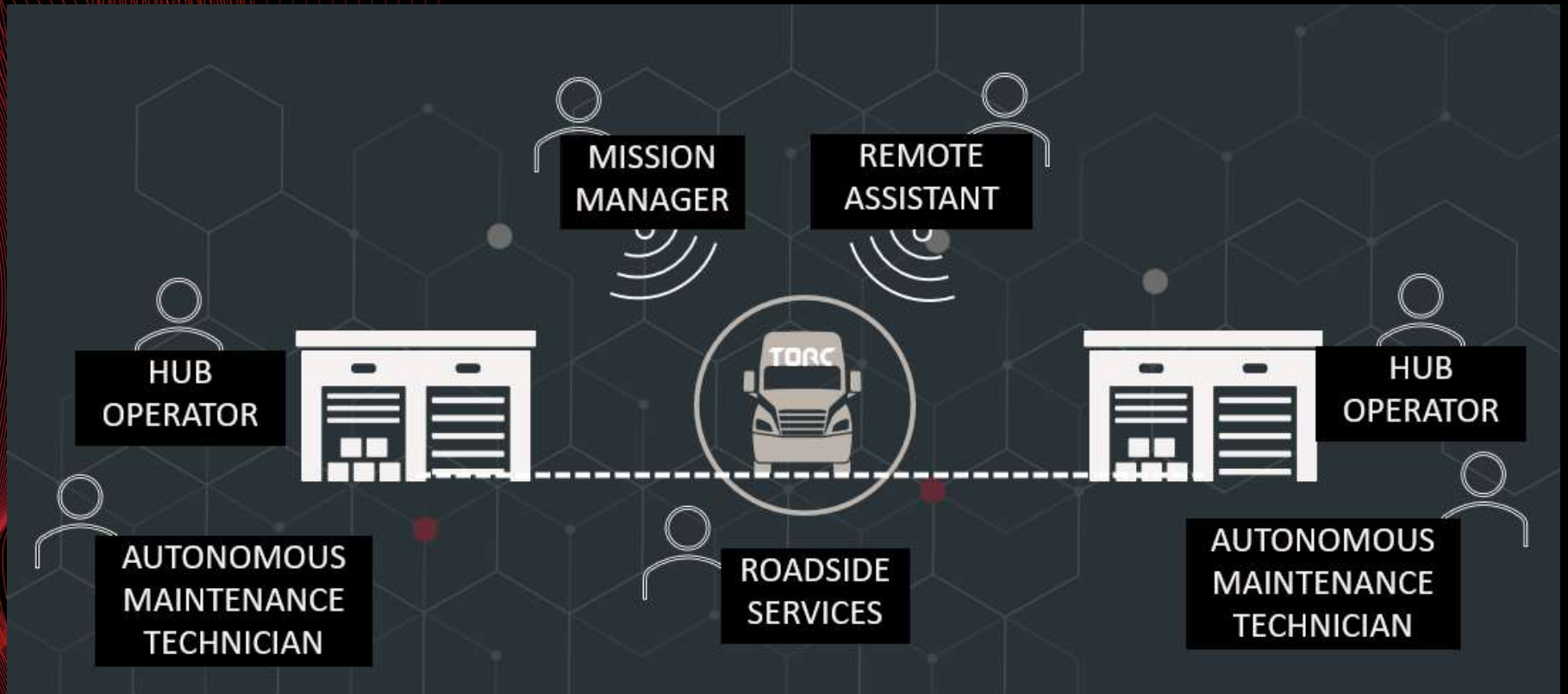
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Business Model:
Virtual Driver
as a Service

Distribution
Last mile



Manual driving

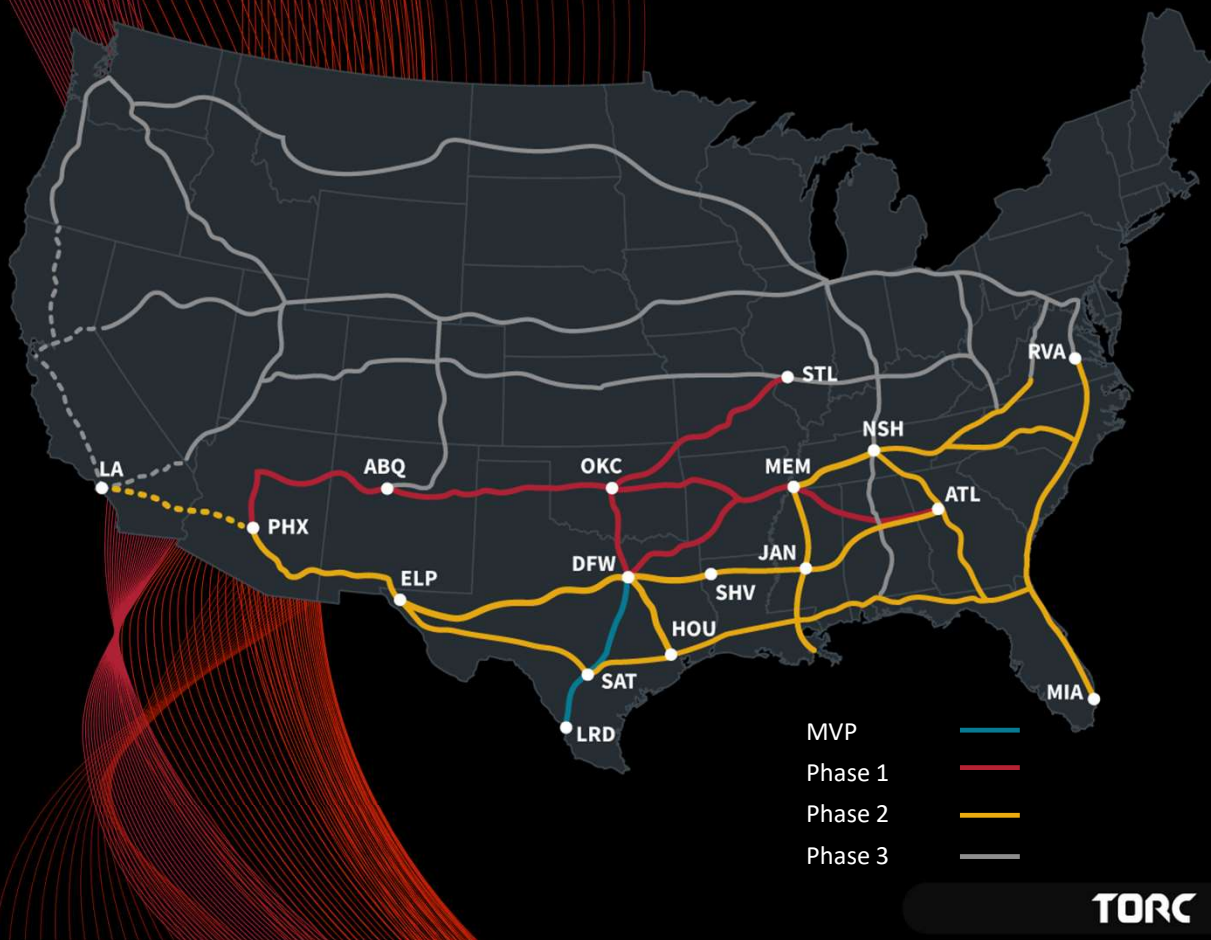
Hub Operations



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Phased Approach Focused on Freight Corridors



Torc's network will be increase in phases

An initial MVP lane in Texas from Ft. Worth to Laredo

Testing with experienced **Human Driver** (with commercial driver's license) behind the wheel supervising the system

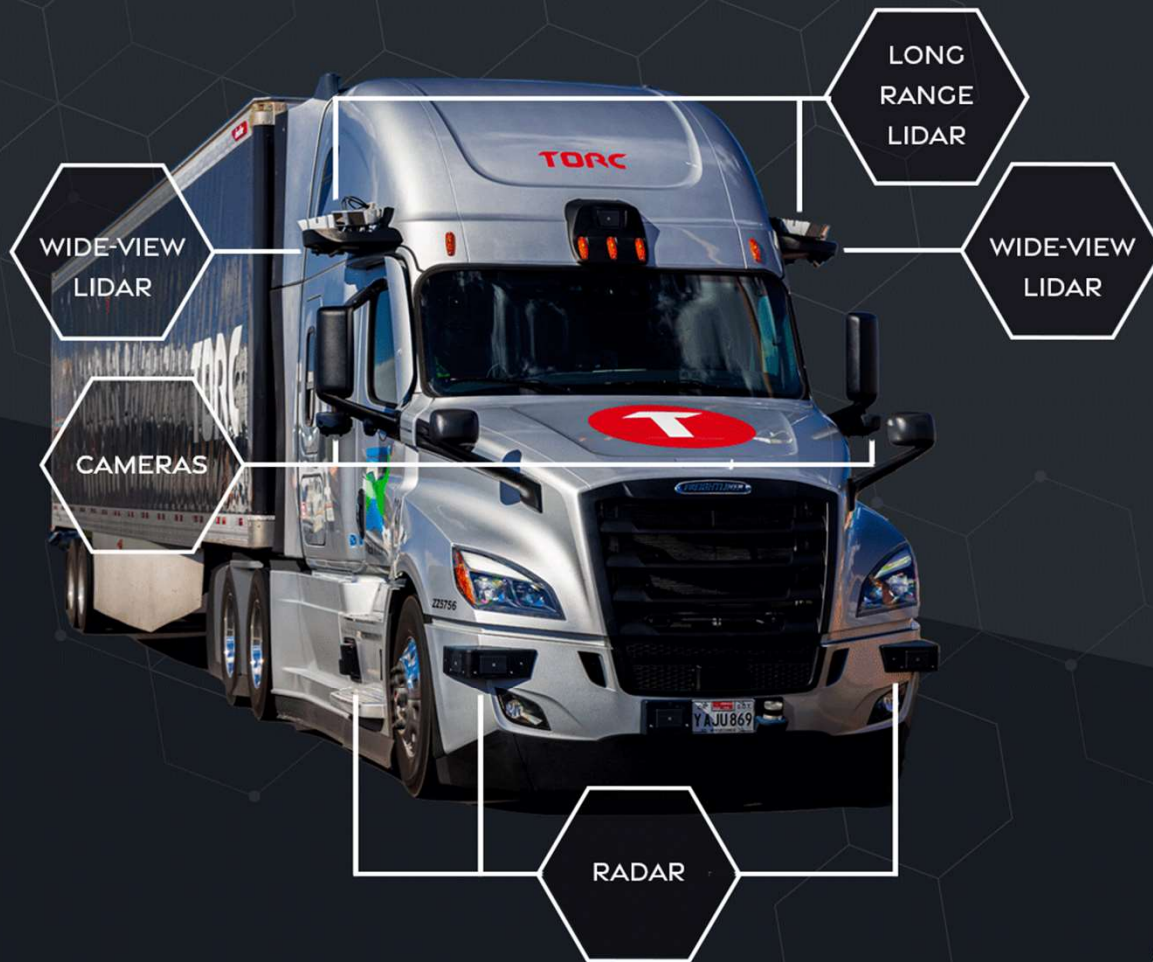
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Technology Overview

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COMPONENTS OF AUTONOMOUS DRIVING



LONG RANGE & WIDE-VIEW LIDAR

- Creates 3D detailed map of the environment
- Performs regardless of light/shadows
- Important for semi-trucks, require longer stopping distances

CAMERAS

- Used for object detection and perception

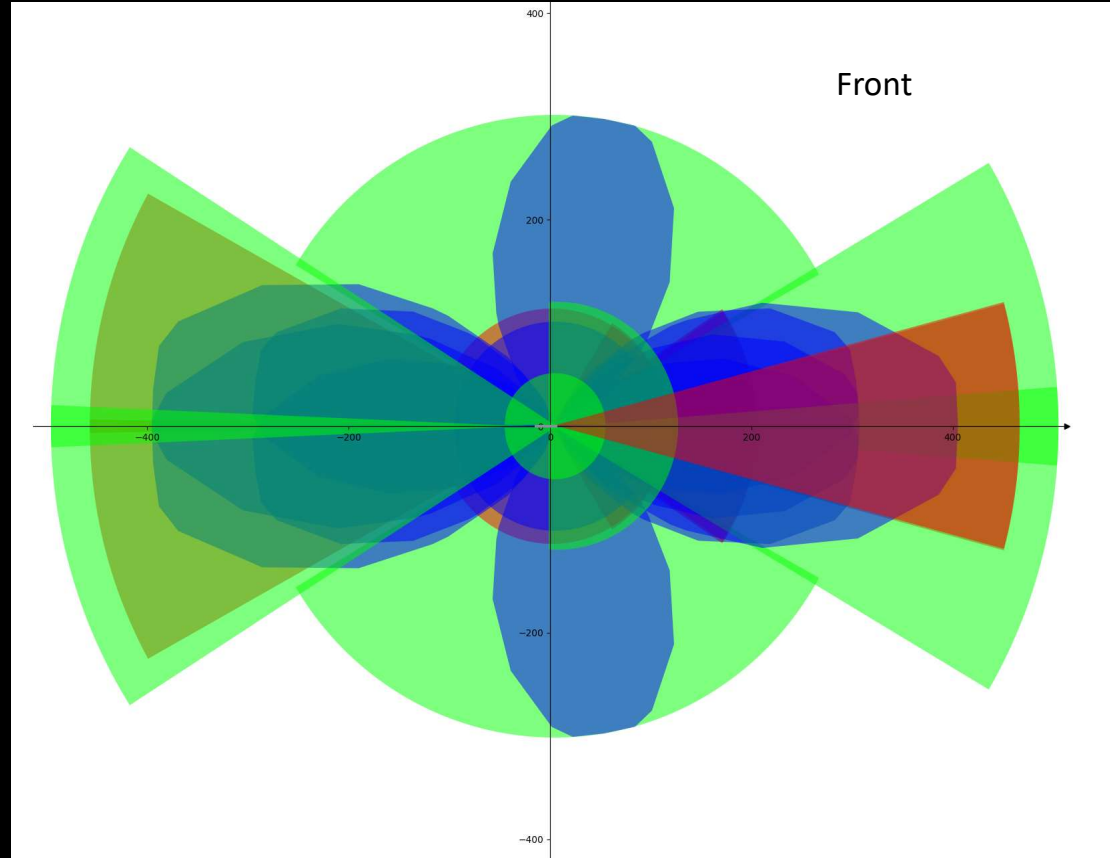
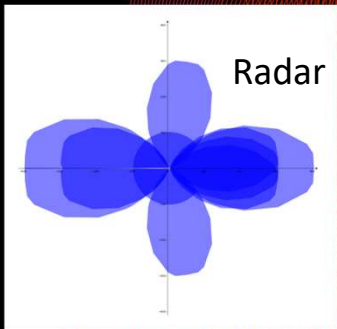
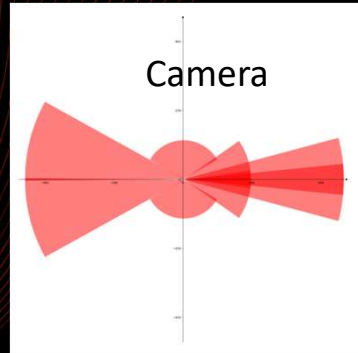
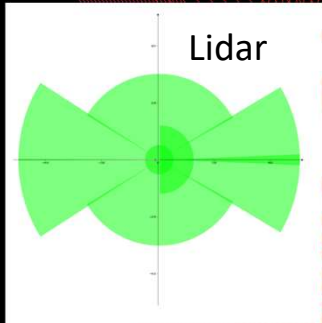
RADAR

- Tracks velocity & speed of objects around vehicle
- Strong performance in weather

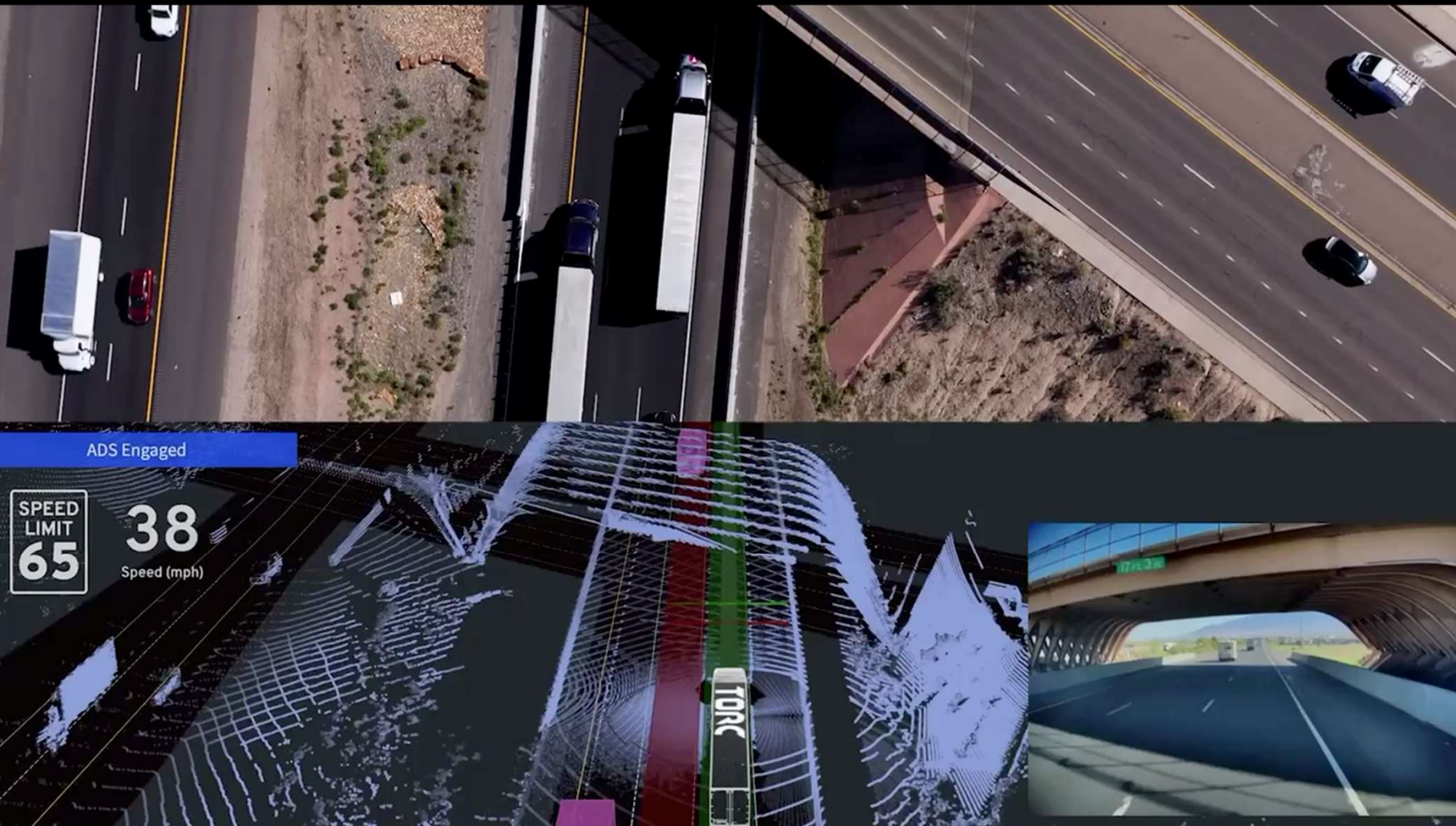
SOFTWARE

- Machine learning

360 Degree Sensor View



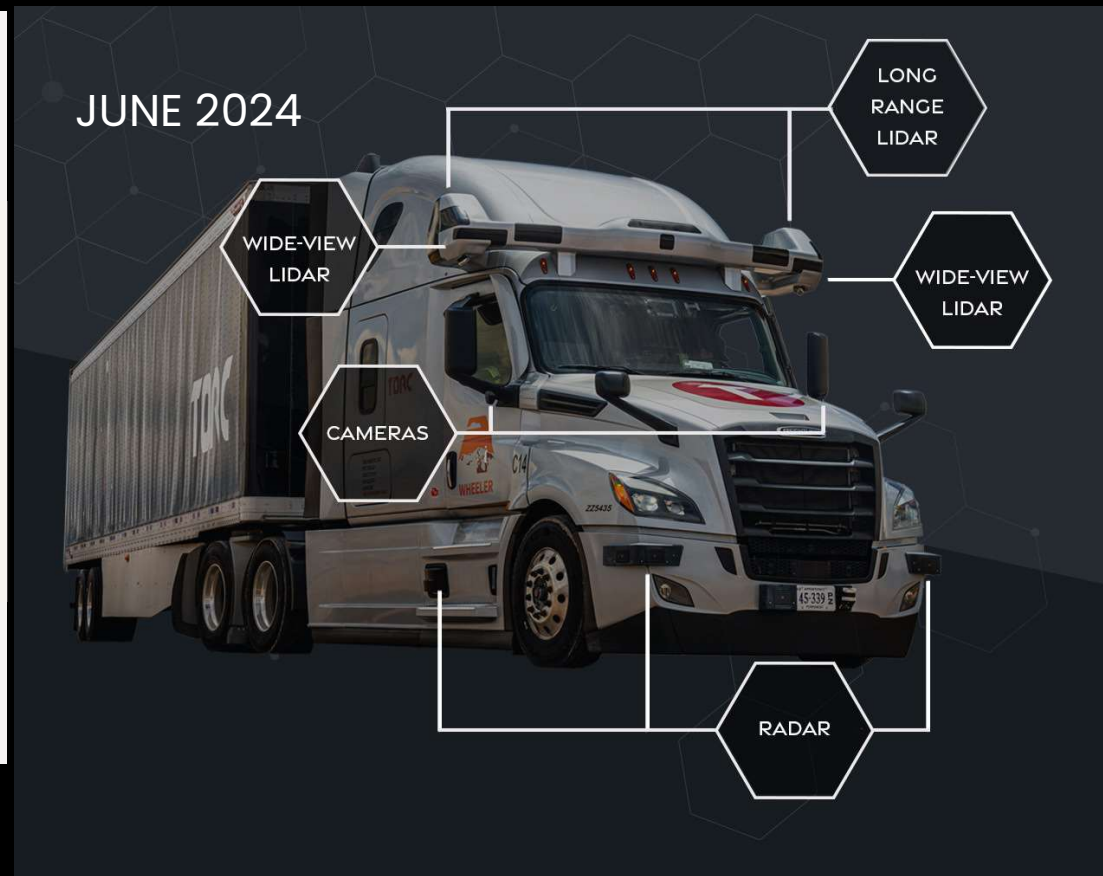
LANE CHANGE



ROBUST LOW-LIGHT PERCEPTION



Redundant Design: Working towards product release



WHAT SAFETY MEANS TO TORC



ACT



KNOWING PERFORMANCE



PROVEN CAPABLE



STATE OF THE ART DESIGN



SAFETY CULTURE & POLICY



OUR COMPREHENSIVE AND INTEGRATED SAFETY CASE FRAMEWORK



ENGINEERING RIGOR

Industry standards and state-of-the-art methods to set performance and fail-safe requirements with provable integrity.



ROADMANSHIP

Truck behaviors are appropriate and courteous responses for sharing the road and building trust.



ROBUST VALIDATION

Comprehensive validation program with traceable requirements to demonstrate and document the capability of our design.



QUALITY ASSURANCE

A quality-focused solution, from the design and tools to product integration and manufacturing.



OPERATIONAL ECOSYSTEM

Operations are conducted in a safe manner and provide suitable maintenance, service, monitoring, and roadside assistance.

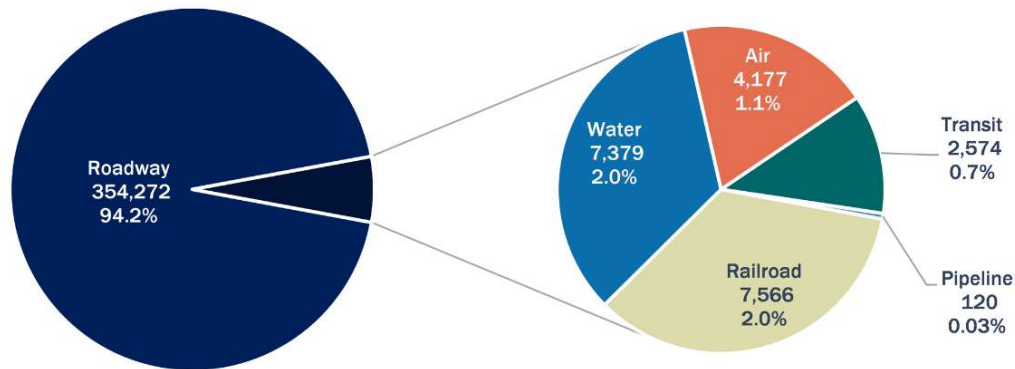
SAFETY MANAGEMENT SYSTEM

Why Autonomous Trucking

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Addressing the Roadway Safety Problem

More than 370,000 people died in transportation incidents over the last decade (2011-2020) in the United States. More than 350,000 of them died on our roads.



- **Over 40,000 motor vehicle related fatalities in 2023**
- **In 2022, over 5K large trucks involved in a fatal crash**
- **Involvement rate per 100 million large truck miles up 24% in last 10 years**

Sources: NHTSA and National Safety Council

Source: <https://www.transportation.gov/NRSS/SafetyProblem> and NHTSA

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Unsafe HUMAN Driving Behaviors

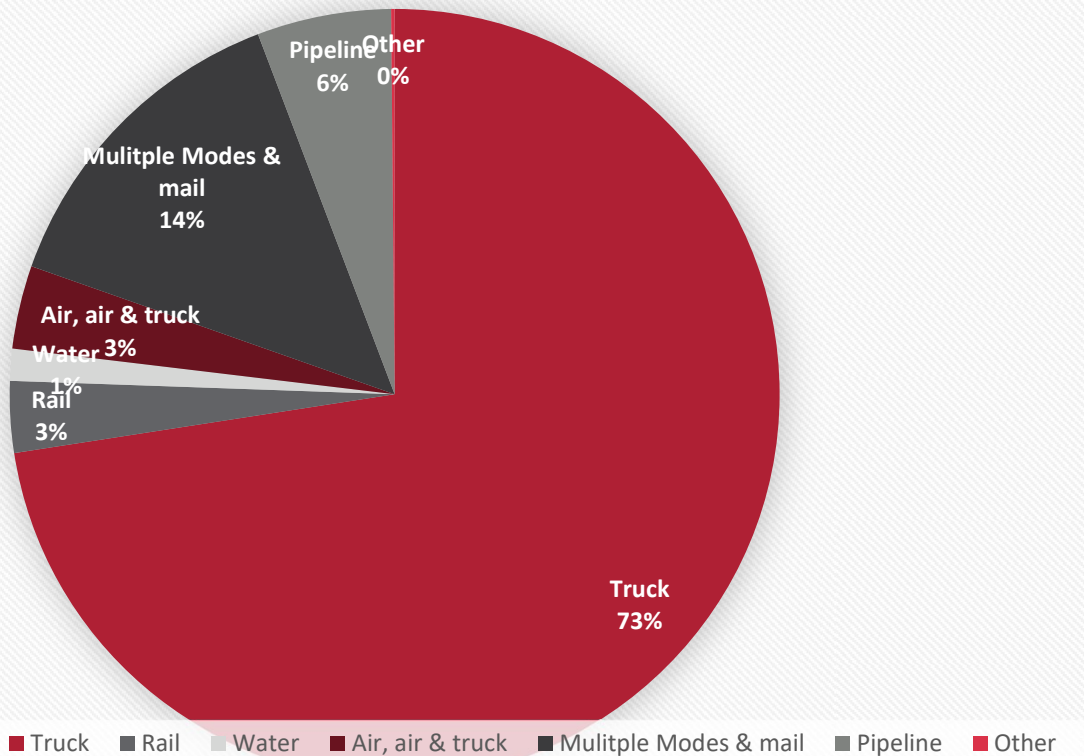
- Driver Distraction
- Driver Fatigue
- Impaired Driving
- Aggressive/Risky Driving

In 2022, 3,308 people killed and additional 289,310 people injured in crashes involving distracted drivers

Source: NHTSA

Supporting the Freight Economy

% of Total Freight Value in US by Mode



➤ 12.6 billion tons moved, valued over 13.6 T in 2022

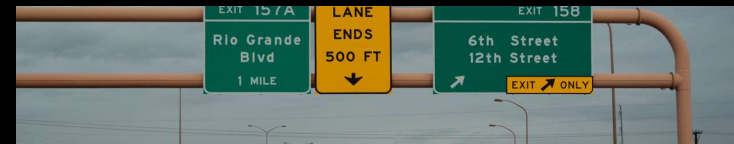
➤ Projected to reach 14.2 billion tons by 2034

➤ Projected shortage of 1M drivers to replace those leaving the industry

➤ Autonomous technology can support growing freight demand and driver shortage

Source: USDOT and American Trucking Association

Autonomous Trucking Use Case



URBAN DRIVING

ON-HIGHWAY DRIVING

Scalability	City-by-city, high cost and complexity	10% of U.S. highways = 80% of transported goods
Environment	Urban	Majority highway (>90%) + Surface street (<10%)
Traffic	Trucks, cars, pedestrians, bikes, public transport	Mainly cars and trucks
Driving	Highly complex driving (traffic lights, pedestrian crossings, etc.)	Easier driving (lane change, etc.)

High complexity due to high variability

Lower complexity/more uniform road design

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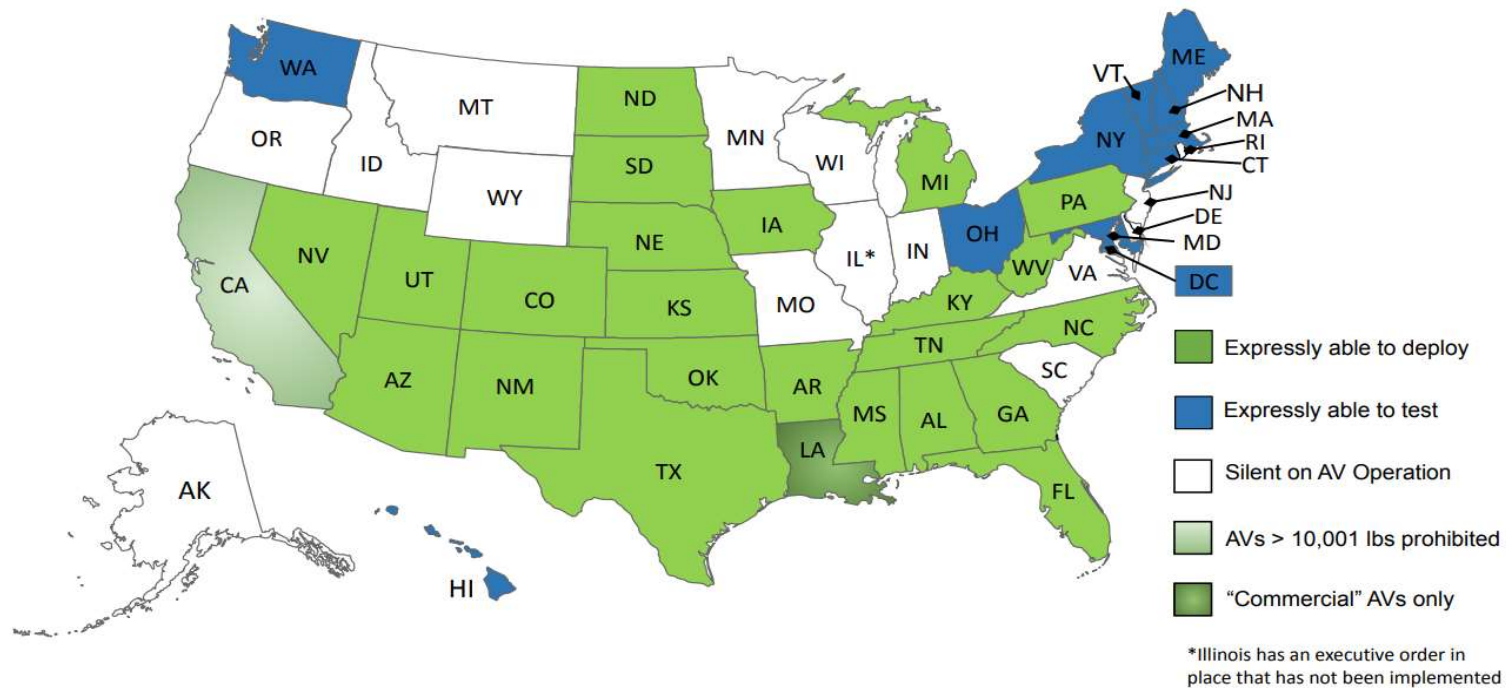
The background of the slide features a blurred image of a blue Freightliner truck. Overlaid on the truck are several wavy, red lines that create a sense of motion and digital connectivity. The text is centered in the upper half of the image.

Policy Landscape for Autonomous Vehicles

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U.S. State AV Laws

U.S. State AV Laws & Regulations



Source: Map from May 2024, Autonomous Vehicle Industry Association

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Regulatory Oversight

Vehicle and Equipment	Testing and Deployment
Federal (NHTSA) regulates the safety of motor vehicles & equipment	States regulate AV testing/deployment on public roads (e.g., requirements on insurance, reporting, etc.)
Vehicle Operation	Commercial Motor Carriers
States regulate AV operations (e.g., enforcing traffic laws, setting requirements, etc.)	Federal (FMCSA) regulates commercial motor vehicle operations (requirements on inspections, licensing, etc.)

Enhanced Inspection Process

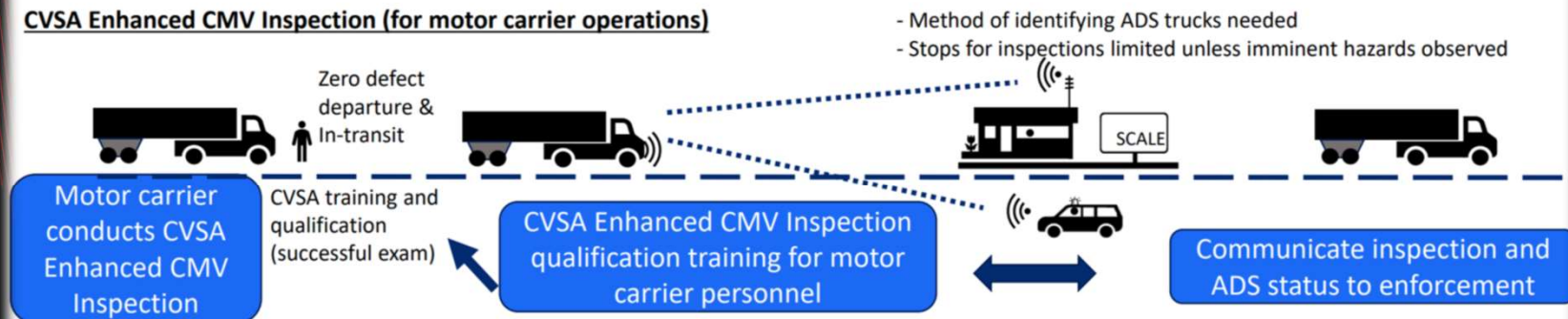
CVSA Enhanced CMV Inspection Process



CVSA North American Standard Inspection



CVSA Enhanced CMV Inspection (for motor carrier operations)



Looking Ahead

FREIGHTLINER

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Partnership and Collaboration

- Industry Associations
- Research Organizations and Academia
- Safety Groups
- Government and Policymakers
- Public

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1ST RESPONDER GUIDE

A COMPREHENSIVE GUIDE AND ONE PAGER FOR 1ST RESPONDERS IN THE EVENT OF AN ACCIDENT

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FIRST RESPONDER QUICK REFERENCE

EMERGENCY CONTACT
Torc's First Response team:
1-888-747-1191

Scan for First Responder guide and additional information.

IDENTIFY

This truck is a modified autonomous-ready Freightliner Cascadia, owned and operated by Torc Robotics, an independent subsidiary of Quince Truck AG.

If Torc authorized personnel are unable to move the truck, contact Torc's First Response team at 1-888-747-1191 and one will be dispatched as soon as possible. This and the Torc First Responder Guide, located in the binocular in the driver side overhead compartment.


VERIFY ADS STATUS

Before removing the truck from the roadway, it is important to ensure that the ADS (Automated Driving System) is fully disabled. You must do this by accessing the cab.


To determine the status of the ADS, the first responder must access the interior of the truck. Indicator lights on the A-pillar of the driver side of the truck show whether the ADS is engaged (green) or available (red). ADS is disengaged when both lights are off.

NOTE: There are no ADS features to consider when detaching a trailer from the tractor; all ADS hardware is located on the tractor.

SEE BACK SIDE FOR MORE >



TORC: TRUCKING AND LOGS



Green light (engaged)
Red light (available)

SECURE

To ensure that the ADS remains disengaged, and the truck is stationary, the following steps should be taken in sequence:

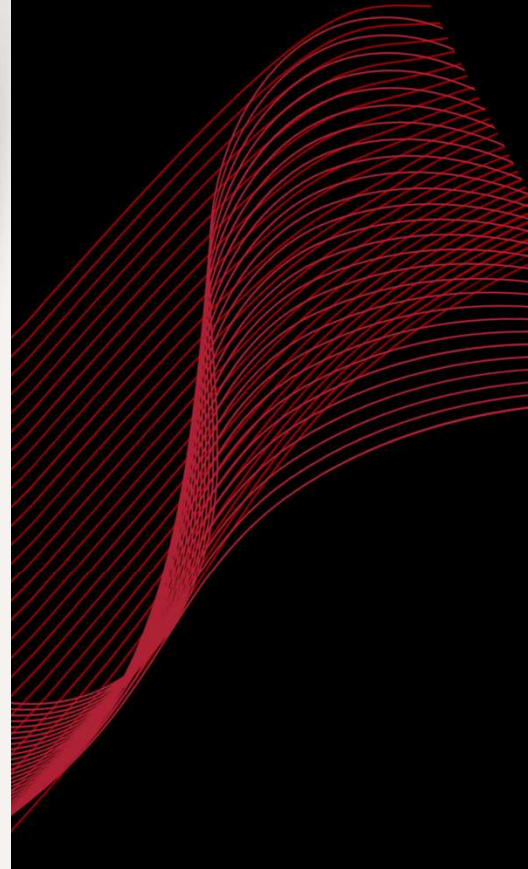
1. Press the Emergency Manual Override (EMO) button to ensure ADS is disengaged.
2. Pull the parking brake (yellow) and trailer air supply (red) buttons.
3. Turn off the ignition.
4. Locate and pull the BAGGAGE handle just inside the rear edge of the driver-side cab door opening to access the baggage compartment.
5. Turn the red ADS power switch to OFF to cut direct current (DC) power to the ADS.
6. Toggle the black power switch to OFF to cut alternating current (AC) power.

ELECTRICAL WIRING

Electrical wiring (120V AC and 48V DC) is located underneath the cab. PLEASE NOTE: Do not cut. High voltage is connected to the ADS computer equipment located directly behind the driver seat in a black metal cabinet with the Torc logo.



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Driving the Future of Freight

Big Dawgs In Automated Trucking Make Big Moves Towards Commercialization

Richard Bishop Contributor @

I first rode in a self-driving vehicle in 2016. Haven't looked back.



Aug 21, 2023, 10:42am EDT



Listen to article 25 minutes



See vehicles, a subsidiary of Volvo, Inc. ...

2023-08-21-10:42



- Prioritizing Safety
- Demonstrating Value
- Transparency and Collaboration

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FOLLOW OUR JOURNEY

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Check out our website:
torc.ai



Follow us on social media:



Email your questions:

Anita.kim@torc.ai

Paul.Schmitt@torc.ai



Check out our open positions:
torc.ai/careers