ALBERTA MOTOR TRANSPORT ASSOCIATION

# Cooperative Truck Platooning System


2021/2022

PREPARED AND PRESENTED BY

AMTA Alberta Motor Transport Association

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The Cooperative Truck Platooning System (CTPS) trial successfully demonstrated two Class 8 connected automated vehicles (CAVs). Each truck was equipped with Level 2 driving automation that supported lane centering, and adaptive cruise control features. The vehicles platooned as a "road train" separated by three, four, or five-second intervals. This trial is the first study in Canada to demonstrate CTPS in business operations on public roads.

A 'test-bed' approach was used to validate technology readiness through system monitoring and oversight. Over 225 track tests were completed to analyze single truck breaking, platooning breaking, traffic vehicle cut-ins, sudden reveal traffic, automatic emergency braking, connectivity, as well as daylight and nighttime operations. Demonstrations then progressed to road trials where the advanced driver system was safely integrated into real-world traffic scenarios.

Extensive vehicle instrumentation was completed to collect trial data. Vehicle operations were conducted on Queen Elizabeth Highway 2, Alberta's busiest corridor, during the fall and winter seasons. Trials contrasted non-platooning and platooning operations and captured the benefits and vulnerabilities of this new technology.

Through this trial, instantaneous fuel consumption was measured to identify if vehicle-to-vehicle communication with forward sensors was able to maintain constant following distance and shorter gaps between the vehicles. This would result in potential fuel efficiencies.

The platooning trials also measured how vehicle acceleration and deceleration, traffic interactions, vehicle weight and road conditions contributed to fuel consumption. Trials were conducted, in part, to identify if platooning technology has the potential to reduce greenhouse gas emissions and contribute to a more efficient transportation network.

# EXECUTIVE SUMMARY

## TRIALS AND PROJECT OUTCOMES

### Feasibility and Safety

The trials confirmed that CTPS technology can be used to support freight transport during Canadian winters. Through the trial, CTPS was engaged for over 22,855km with no hazardous sudden braking or traffic events.

### Platooning Engagement

From January to February, platoon engagement ratios varied. On average, a platoon ratio of 55% was achieved with a maximum platooning engagement ratio of 96%. Winter road conditions included bare dry, bare wet, partial snow cover, and shoulder ice/snow surfaces.

### Acceleration Profile

Over 60% of the trips included at least one acceleration event. The follower truck experienced 33% more accelerations and 48% more decelerations than the lead truck.

### Fuel Consumption

Instantaneous fuel consumption was measured during the trials. The average fuel consumption for these trips ranged from 0.7 to 1.4 kg/ton•100km. Truck weight was the dominant factor with respect to fuel consumption during platooning. The follower truck generally consumed more fuel than the lead truck during the platooning trials.

### NOx Emissions

The accumulated specific NOx (engine-out) showed higher emissions during trips with light cargo loads. The average specific NOx was about 10 g/(ton 100km). No strong trend was noticed.

### Traffic Interaction

Traffic cut-ins and cut-outs occurred frequently. On average, cut-in events increased from 1.6 times per hour at three seconds to five times per hour at five seconds. This invaluable trial validated the usage of CTPS technology with three- to five-second platooning distances in a variety of road surface conditions during Canadian freight operations.

# INTRODUCTION

## CANADA'S FIRST ON-ROAD COOPERATIVE TRUCK PLATOONING SYSTEM TRIALS

Cooperative truck platooning consists of a lead truck and follow truck that are electronically connected.

Critical data is continuously transmitted from the lead truck to the follower truck to allow optimal braking and acceleration as vehicles interact with road traffic. The engine control unit (ECU) connects the braking and steering to support lane centering and connected adaptive cruise control.

For the trial, two Peterbilt 579 Class 8 trucks were equipped with radar, cameras, GPS, a vehicle-to-vehicle communication system, and other truck sensors.

On-road trials were conducted on Highway 2 from Calgary to Edmonton and back. This route was chosen as it is a divided highway with a variety of grades and long, straight road sections.

The platooning system was engaged from Airdrie to Leduc, a 234 km section of highway.


### Trial Goals

- Validate vehicle safety
- Evaluate fuel consumption
- Review tailpipe emissions and air pollutants
- Examine traffic flow interactions
- Assess the driver experience
- Create an awareness of automated and connected vehicle technologies

# INTRODUCTION

## DRIVER ASSIST TECHNOLOGIES

### TERMINOLOGY

Co-pilot is the term used by Pronto to describe its lane-centering and adaptive cruise control function. This system is manually engaged by the driver.

Co-pilot must be engaged on both the lead and the follower truck before the trucks can act as a platoon.


Pronto provided two vehicles equipped with SAE Level 2 driver-assist systems. Pronto also provided technology support, as well as subject matter experts to complete driver training. The Pronto driver-assist system supports steering and deceleration/ acceleration (simultaneous lane-centering and adaptive cruise control). Level 2 automation systems require the driver to constantly supervise the vehicle and be ready to take control of the truck as needed. This is often referred to as 'Driver in the Loop'.

To engage the trucks in a platoon, the following conditions must be met:

1. THE FOLLOWER TRUCK AND LEAD TRUCK MUST BOTH BE IN 'CO-PILOT' MODE.
2. THE FOLLOWER TRUCK AND THE LEAD TRUCK MUST BOTH BE IN THE SAME LANE.
3. TO FIRST CONNECT THE TRUCKS AS A PLATOON, A VEHICLE CANNOT BE IN BETWEEN THE CO-PILOTING TRUCKS.

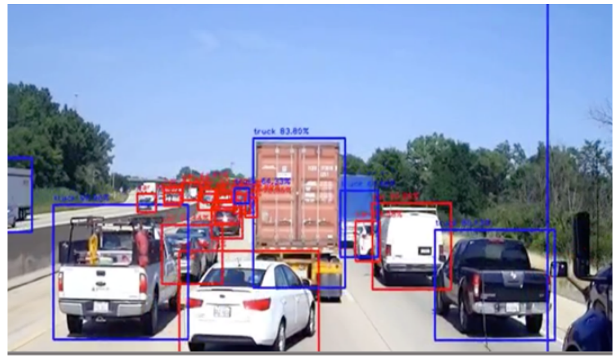
# INTRODUCTION

## DRIVER-ASSIST TECHNOLOGIES

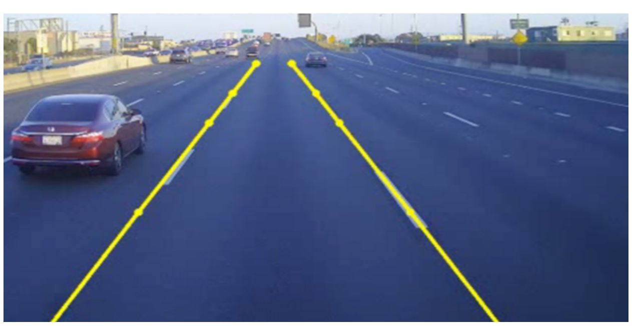
Forward-facing cameras are mounted in the windshield and front bumper. These cameras identify objects in front of the vehicle as road obstacles.

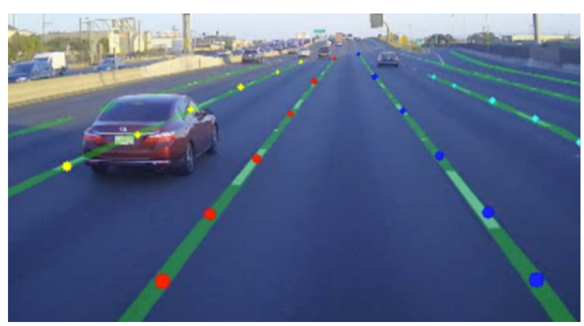
Onboard sensors automatically adjust the vehicle speed to maintain a safe distance from the obstacles in front of the vehicle.

Driver-assist technologies are being advanced to save lives, prevent injuries, and reduce road accidents.



Forward-facing radar translates road markings into a matrix of dots and dashes that centre the vehicle in the lane of travel.





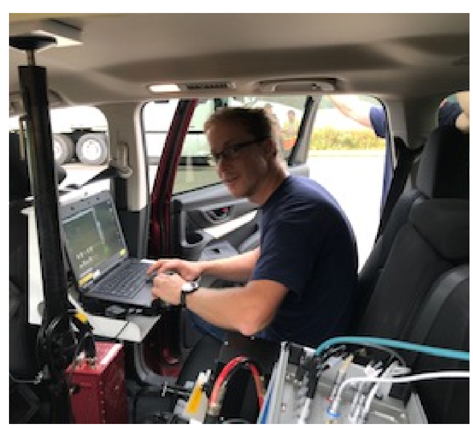
# ON-TRACK VALIDATION

## PMG TECHNOLOGIES TEST AND RESEARCH CENTRE

Technology testing was completed at PMG Technologies in Blainville, Quebec. A total of 225 tests were conducted.

Initial testing was completed at lower speeds utilizing a programmable soft target. This 'soft target' was designed specifically for the trials on a skateboard frame.
That 'soft target' was safe to drive over and simple to reconstruct if a vehicle hit occurred. Higher speed-testing was completed with a programmable robotic car. Track-testing parameters reviewed included:

1. **SINGLE-TRUCK BREAKING**
   LEAD TRUCK, FOLLOW TRUCK
2. **PLATOON-BREAKING**
   CONSTANT SPEED, ACCELERATION, DECELERATION
3. **TRAFFIC CUT-INS**
   SAME SPEED, DECELERATION, ACCELERATION
4. **SLOWER-MOVING TRAFFIC**
5. **AUTOMATIC EMERGENCY BRAKING**
6. **DAY AND NIGHT TESTING**
7. **DRY AND WET SURFACE TESTING**
8. **SUDDEN TRAFFIC REVEAL**

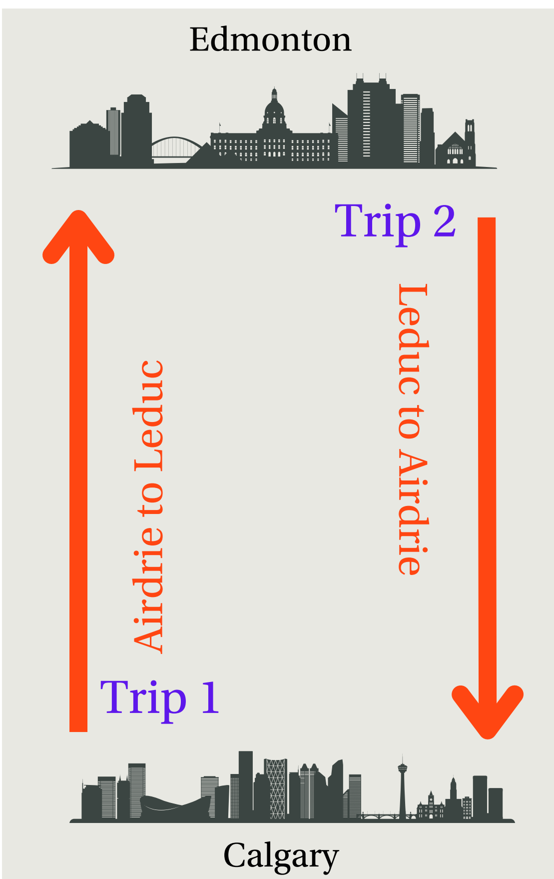


# ON-ROAD TESTING

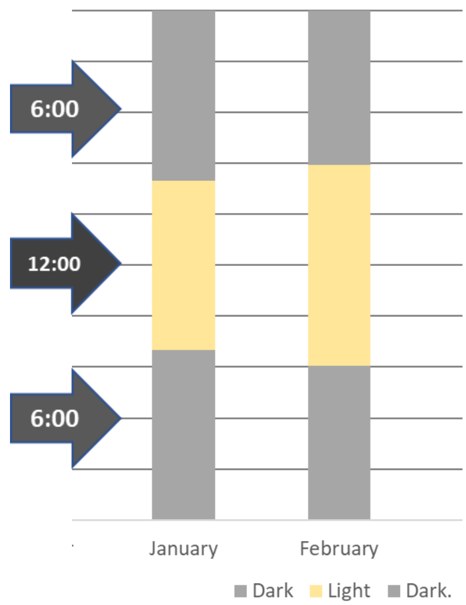
## TRIAL ROUTE

On-road activities began in October 2021 and concluded February 2022.

During the trials, drivers picked up their first load in Calgary and then dropped this load in Edmonton. A second load was then acquired for the return trip to Calgary. All trips began and ended at Bison Transport in Calgary.




Drivers departed Calgary around 7:00am and returned to Calgary as the sun was setting between 5:00 and 7:00pm. The majority of the trips were completed during daylight hours.




The co-pilot and platooning systems were only engaged outside of the city limits between Airdrie and Leduc.

The total distance from Calgary to Edmonton and back was 660 km.

# ON-ROAD TESTING

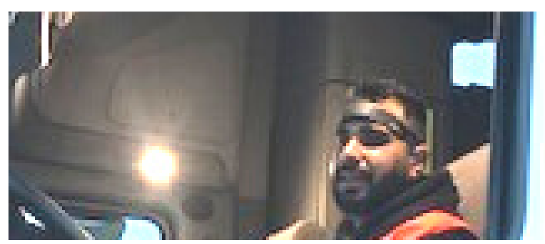
## DRIVERS

Drivers completed driver training and participated in a detailed information session before the trials began.

For each trip, drivers completed a set of tablet-based cognitive tasks (TBCT) at the beginning and end of their shift. While the drivers interacted with the driver assist and platooning technology, brain activity was monitored using a Muse headband, and eye gaze and blink rate were captured through a dash a mounted eye-tracking system (see below).

Nine drivers participated in the CTPS trials. Unfortunately, trending driver conclusions were not attained. The number of participants or length of the trials would need to be significantly increased to attain data that could be used to predict future events. A special thank you goes out to the drivers willing to advance this first on-road Canadian trial.

Data collection did confirm that the equipment used was well suited for the trial. Human data was also able to be synchronized to time-stamped driving events that were hoped to support conclusive and trending analysis. Collecting driver data proved to be a highly labor intensive process.



# DATA COLLECTION

## VEHICLE DATA SUBSYSTEMS AND VARIABLES

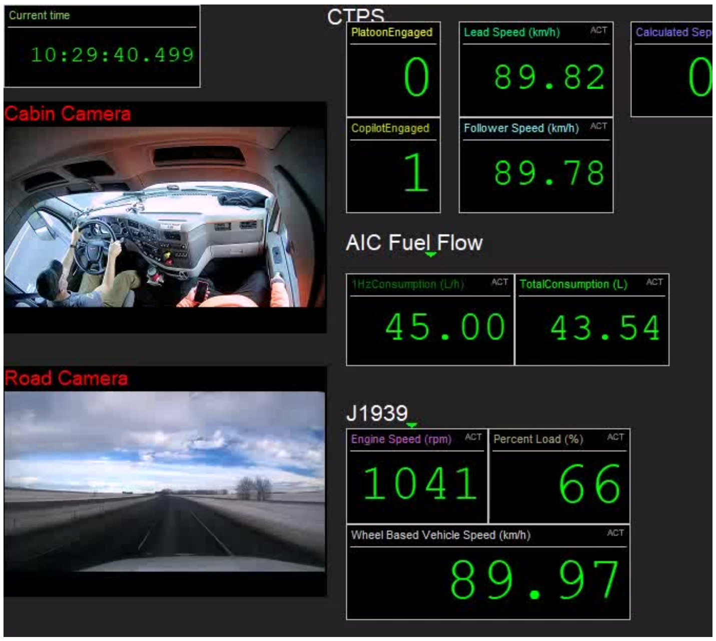
The lead and follower trucks were both equipped with nine subsystems that collected synchronized and time-stamped trial data.

| SUBSYSTEM | VARIABLE |
|---|---|
| PLATOONING PERFORMANCE AND PARAMETERS | • RADAR<br>• DISTANCE GAP BETWEEN TRUCKS<br>• FORWARD-LOOKING VIDEO<br>• RADAR<br>• DISTANCE GAP BETWEEN TRUCKS<br>• FORWARD-LOOKING VIDEO |
| FUEL CONSUMPTION AND EMISSIONS | • FUEL MASS FLOW-RATE, FOLLOWER TRUCK<br>• FUEL MASS FLOW-RATE, LEAD TRUCK<br>• NITROGEN OXIDES<br>• CARBON DIOXIDE EMISSIONS |
| VEHICLE | • ACCELERATION<br>• BRAKING<br>• TRUCK AND TRAILER WEIGHT<br>• INSTANTANEOUS FUEL CONSUMPTION |
| VEHICLE CABIN | • HVAC PARAMETERS TEMPERATURE, BAROMETRIC PRESSURE, RELATIVE HUMIDITY, AND CO2<br>• DRIVER-FACE VIDEO FOR EMOTIONAL IDENTIFICATION<br>• STEERING WHEEL AND CABIN VIDEO |
| VEHICLE DYNAMICS | • WHEELS ROTATIONAL SPEED<br>• YAW ANGLE AND SPEED<br>• STEERING WHEEL<br>• ROLL ANGLE AND SPEED |
| WEATHER | • TEMPERATURE<br>• WINDSPEED<br>• DIRECTION<br>• RELATIVE HUMIDITY<br>• PRECIPITATION |
| TRAFFIC | • VEHICLE INTERACTIONS<br>• TRAFFIC VOLUME |
| GPS | • POSITION<br>• SPEED<br>• ROAD SLOPE |
| DRIVER | • COGNITION<br>• ELECTROENCEPHALOGRAM (EEG)<br>• EYE MOVEMENT AND BLINK RATE |

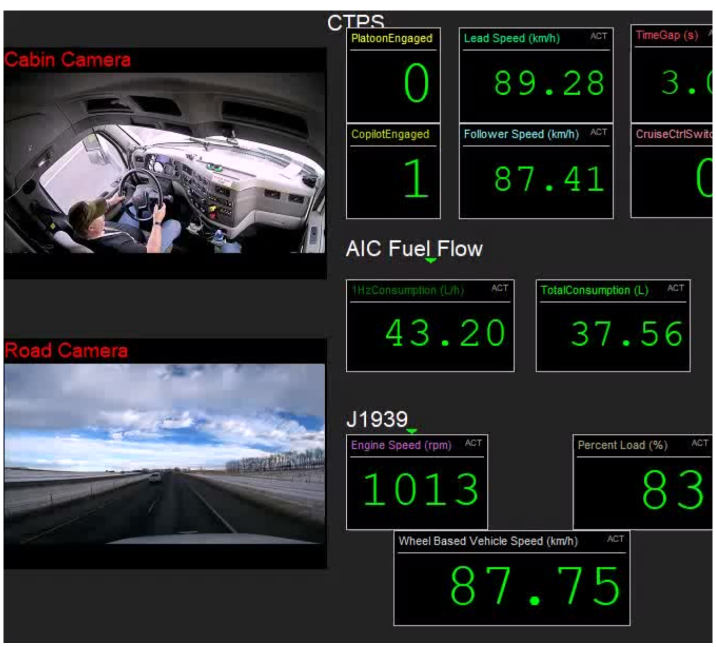
# DATA COLLECTION

## VEHICLE AND SUBSYSTEM DATA COLLECTION

### Lead Truck




### Follower Truck




Vehicle data collection was monitored at the beginning and end of each trip to ensure successful data collection.

Remote live monitoring was enabled by various data recording systems.

A custom-designed data acquisition (DAQ) system collected, saved, and time-synchronized subsystem data. Platooning performance (radar distance), instantaneous fuel consumption, GPS, vehicle speed, acceleration, powertrain, exhaust aftertreatment, vehicle cabin, weather, traffic, and driver behaviour data were collected.

Over one terabyte of vehicle performance data was collected during the trial.

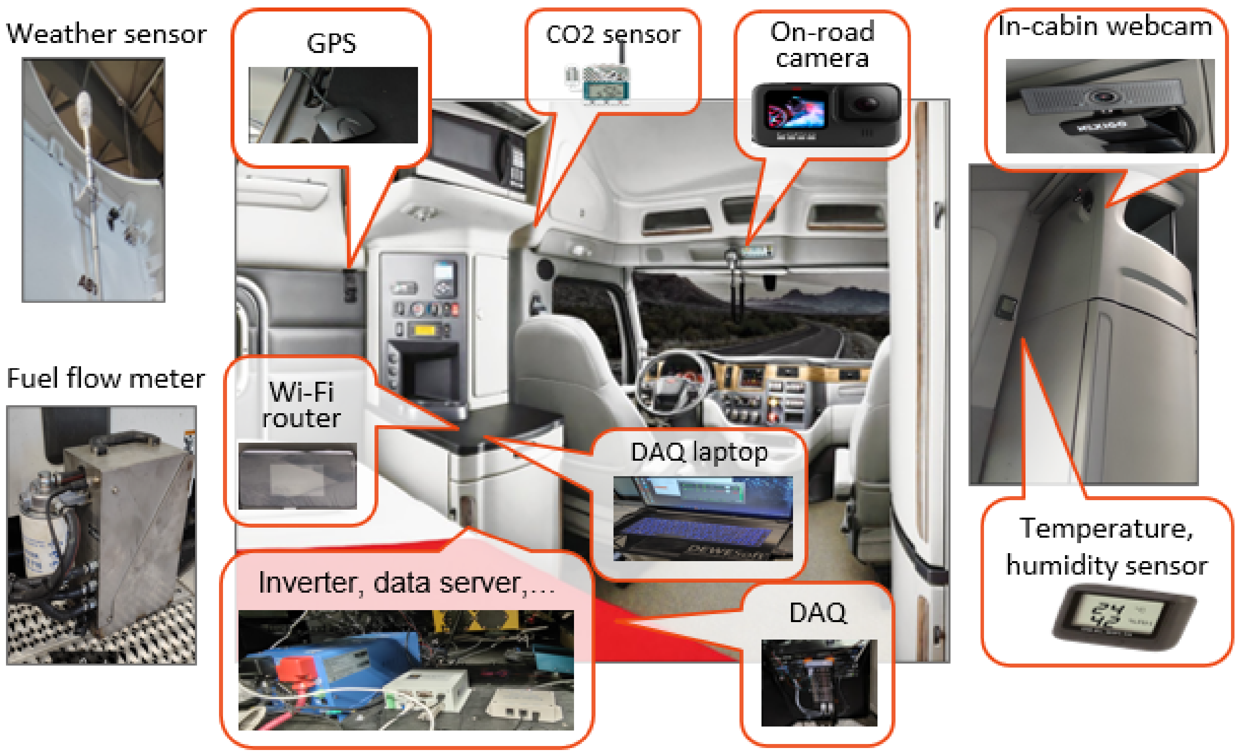
# DATA COLLECTION

## VEHICLE DATA COLLECTION EQUIPMENT

A total of 339 data parametres with up to ten Hertz (10 Hz)* sampling frequency were collected from the two trucks and integrated by the DAQ system.

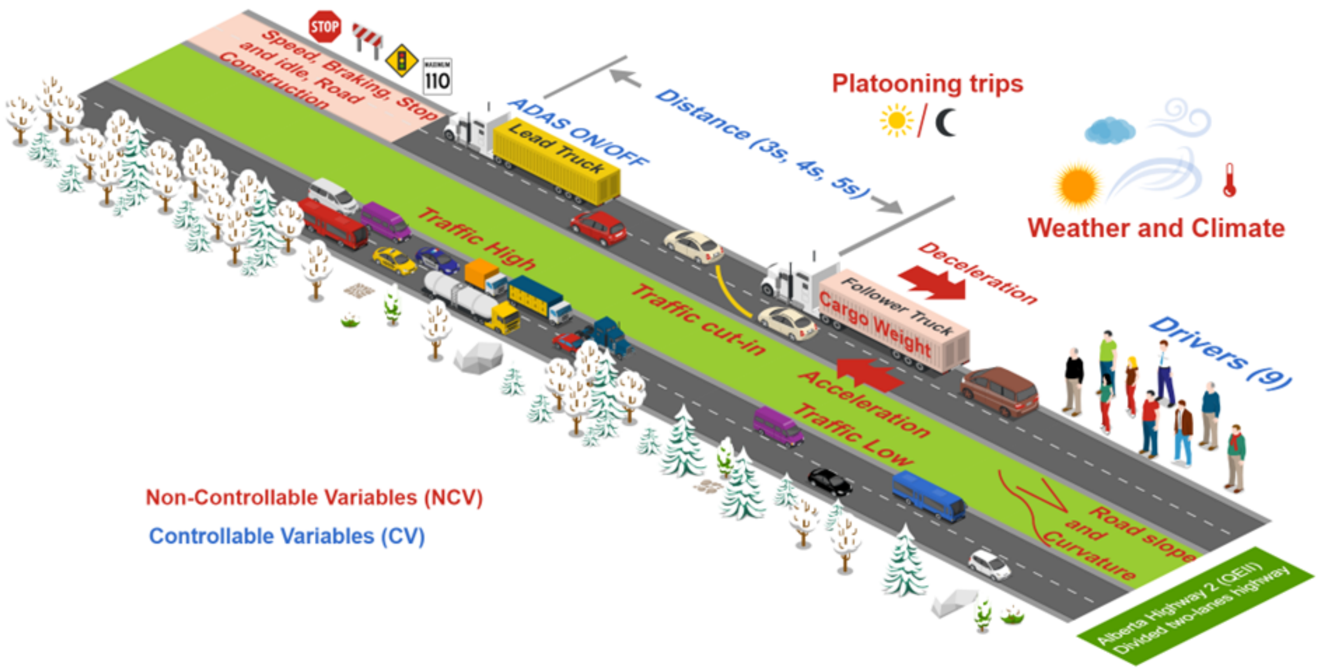
Due to a large number of trial participants and drivers interacting with the vehicles, clear power-up/power-down procedures and processes were articulated to ensure the sensors and devices worked properly. On occasion, human error with start-up or shut-down procedures resulted in data loss or schedule delays, necessitating vehicle boosts or equipment repairs.

*Hertz is a unit of frequency equivalent to one event (or cycle) per second.



# FINDINGS AND TRIAL LIMITATIONS

## SUMMARY

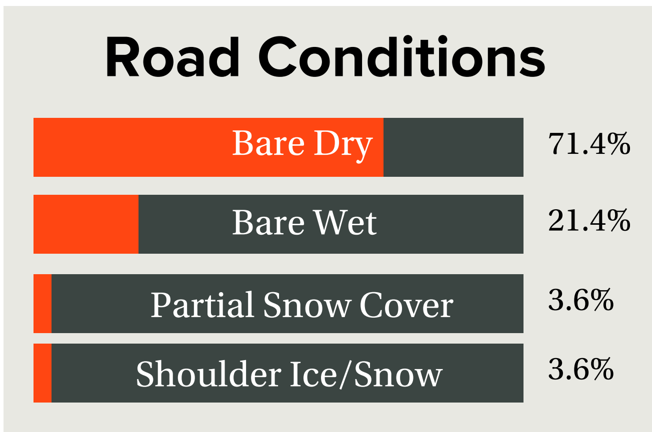



| TASK | TOTAL |
|---|---|
| NUMBER OF PLATOONING TRIPS | 28 |
| TOTAL MILEAGE | 22,800 KM |
| PLATOONING ENGAGEMENT | 41% - 96% |
| TIME GAP | 3, 4, 5 SECONDS |

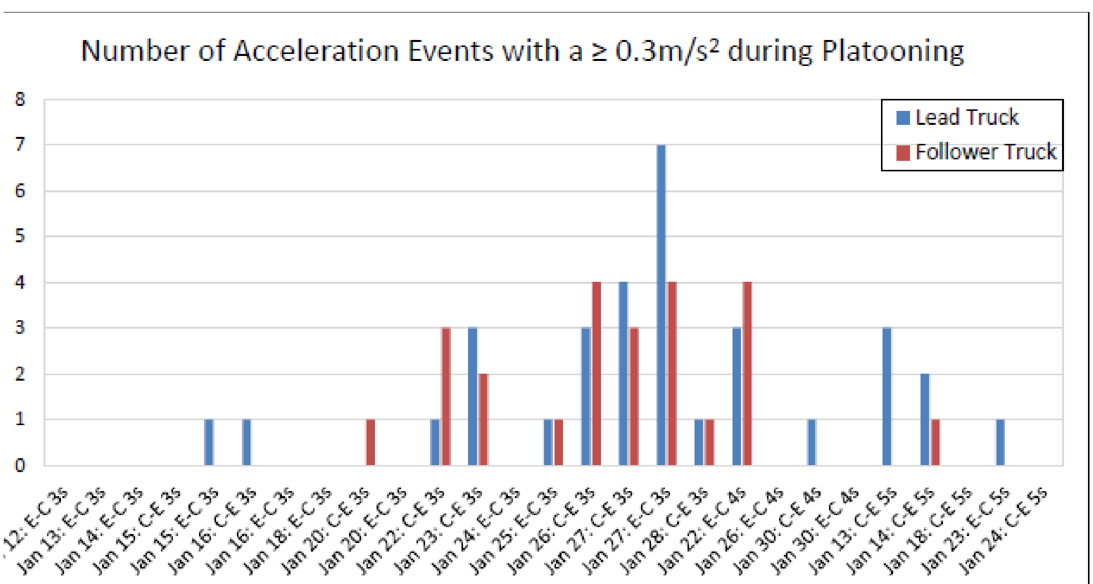
# FINDINGS AND TRIAL LIMITATIONS

## WEATHER

Road-surface conditions during the trial included bare dry, bare wet, partial snow cover, and shoulder ice/snow. The largest portion of the trials were bare dry, accounting for 71.4% of the platooning trial. The remaining trips experienced freeze/thaw road conditions, partial snow cover, and shoulder ice/snow road conditions. Drivers were instructed to apply existing cruise-control company protocols to engage driver-assist and platooning features.



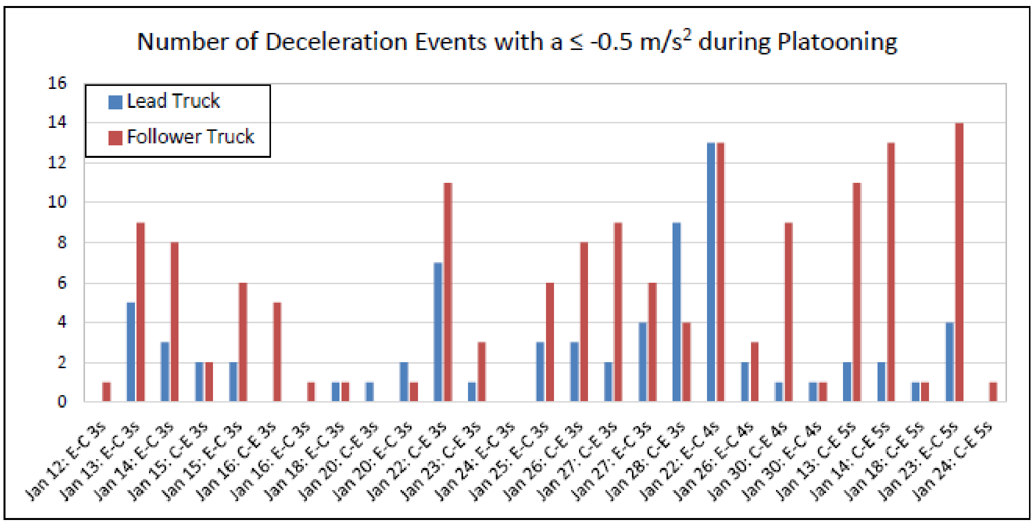

## ACCELERATION EVENTS



# FINDINGS AND TRIAL LIMITATIONS

There were a total of 32 acceleration events (a ≥ 0.3 m/s²) for the lead truck and 24 acceleration events (a ≥ 0.3 m/s²) for the follower truck. On January 22, 23, 25, and 26 platooning trips, the maximum acceleration was 0.40 m/s² in the follower truck. 60% of platooning trips experienced at least one acceleration event of ≥ 0.3 m/s²; with the follower truck having fewer high-acceleration events than the lead truck.

#### DECELERATION EVENTS

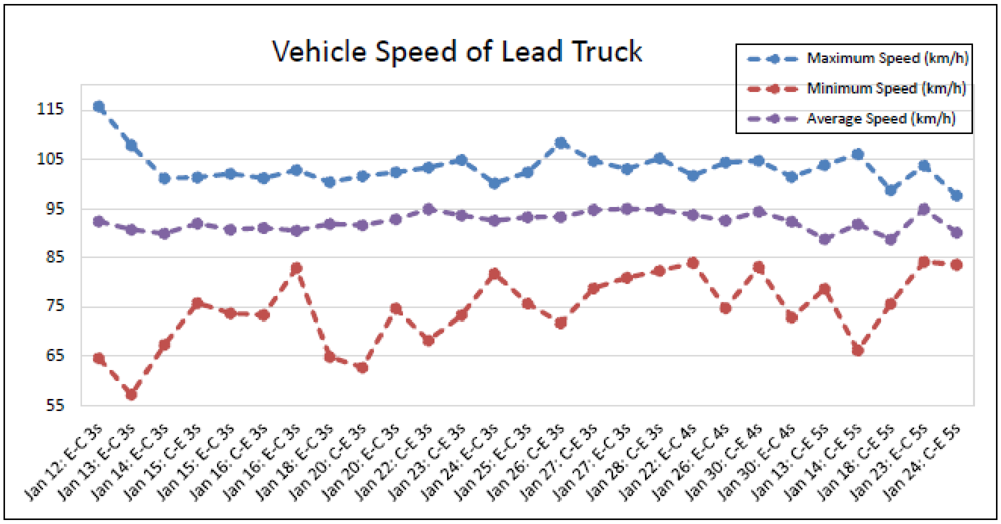



In total, there were 71 deceleration events (a ≤ -0.5 m/s²) for the lead truck, and 147 deceleration events (a ≤ -0.5 m/s²) for the follower truck. 73% of platooning trips experienced at least one deceleration event of a ≤ -0.5 m/s².

The follower truck experienced a greater number of deceleration events than the leading truck. On January 23, a close proximity cut-in occurred, which caused the follower truck to decelerate by 2.02 m/s². This was the greatest deceleration event that occurred during the trials.

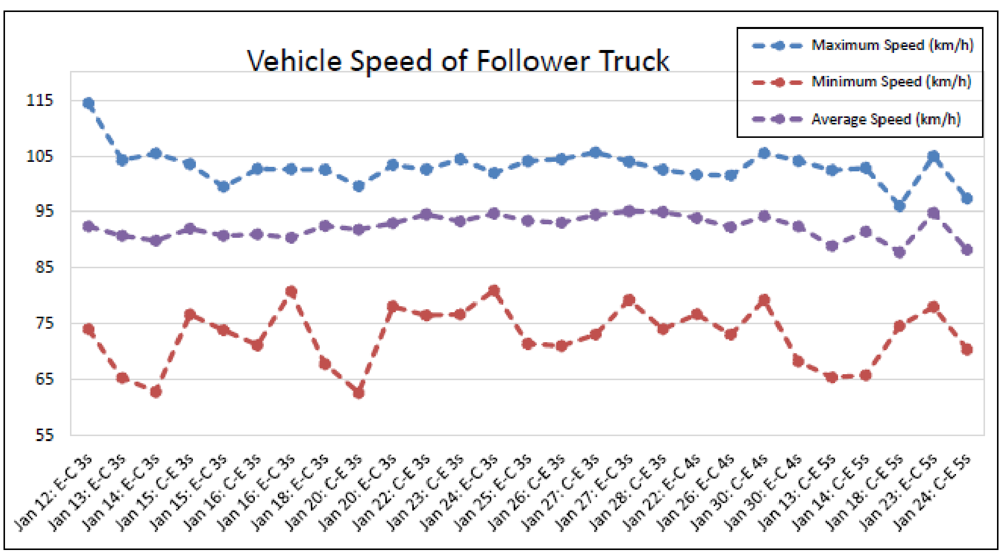
# FINDINGS AND TRIAL LIMITATIONS

## VEHICLE SPEED DURING PLATOONING




**Lead Truck**

Maximum Speed Range: 97.6 - 115.8 km/h
Minimum Speed Range: 57.2 - 84.2 km/h
Average Speed Range: 88.7 - 95.0 km/h




**Following Truck**

Maximum Speed Range: 96.1 - 114.5 km/h
Minimum Speed Range: 62.6 - 80.9 km/h
Average Speed Range: 87.6 - 95.2 km/h

# FINDINGS AND TRIAL LIMITATIONS

**FUEL CONSUMPTON - LIMITATIONS**

Analysis of the fuel consumption behaviour was conducted using real-time consumption measurements through the AIC fuel-flow meter.

The fuel flow meter was installed upstream from the fuel line, to monitor fuel from the fuel tank as it passed to the engine. There was a water separator between the AIC flow meter and the engine.

Water separators always have an empty cavity filled with air. The air-filled volume acts like a compressible medium and causes the fuel flow to be dependent on a range of pressure differences. Pressure variances will cause a time delay for instantaneous fuel consumption measurement.

For the CTPS trials, all of the fuel consumption values are reported from the AIC flow metres except when indicated.

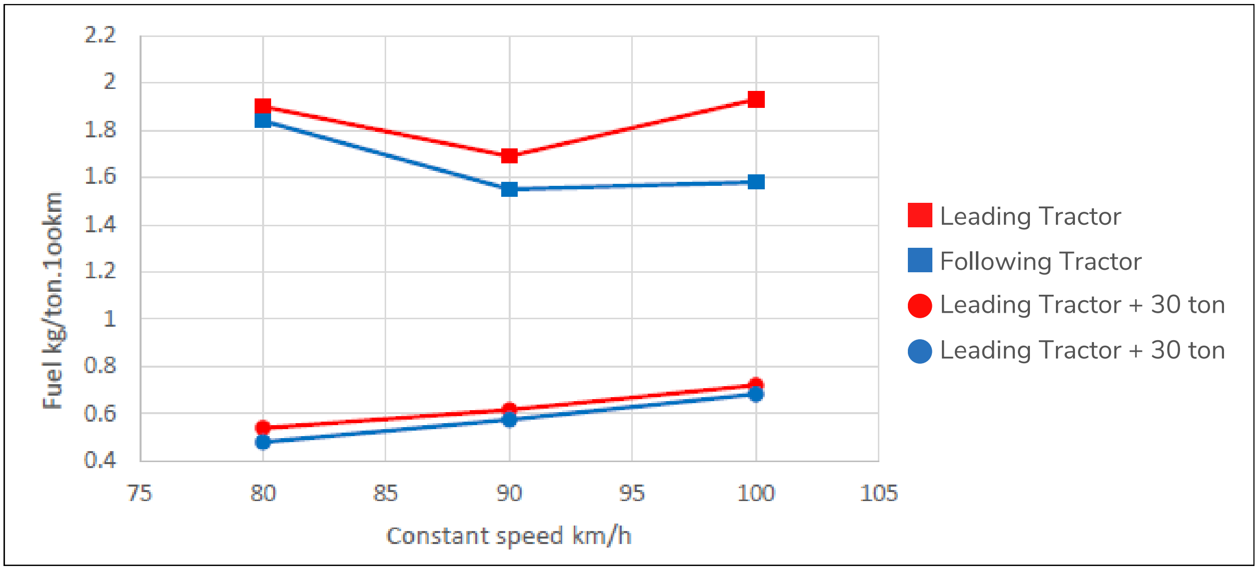
**FUEL CONSUMPTION FOR THE LEAD AND FOLLOWER TRUCKS CAN DIFFER GREATLY, MAKING COMPARISONS WHILE PLATOONING COMPLEX.**

The fuel consumption for identical makes and models of trucks can vary due to manufacturing differences and small variances between powertrain systems.

This difference between the fuel consumption of the lead and follower trucks can make it complex when analyzing the comparison of fuel consumption while platooning.

# FINDINGS AND TRIAL LIMITATIONS

### NON-PLATOONING FUEL TESTS




Baseline fuel consumption comparisons for the tractor (only) and loaded truck configurations are shown above. The results compared fuel consumption at three fixed speeds (i.e., 80, 90, 100 km/h). When only the tractor was considered the lead tractor consumed more fuel. When the loaded tractor was considered, the lead vehicle combination attained a slightly higher fuel consumption. Baseline on-road tests are presented in the following table.

| Speed | 80 km/h | 90 km/h | 100 km/h |
|---|---|---|---|
| Tractor | 3% | 9% | 22% |
| Tractor + 30 Ton | 12% | 7% | 6% |

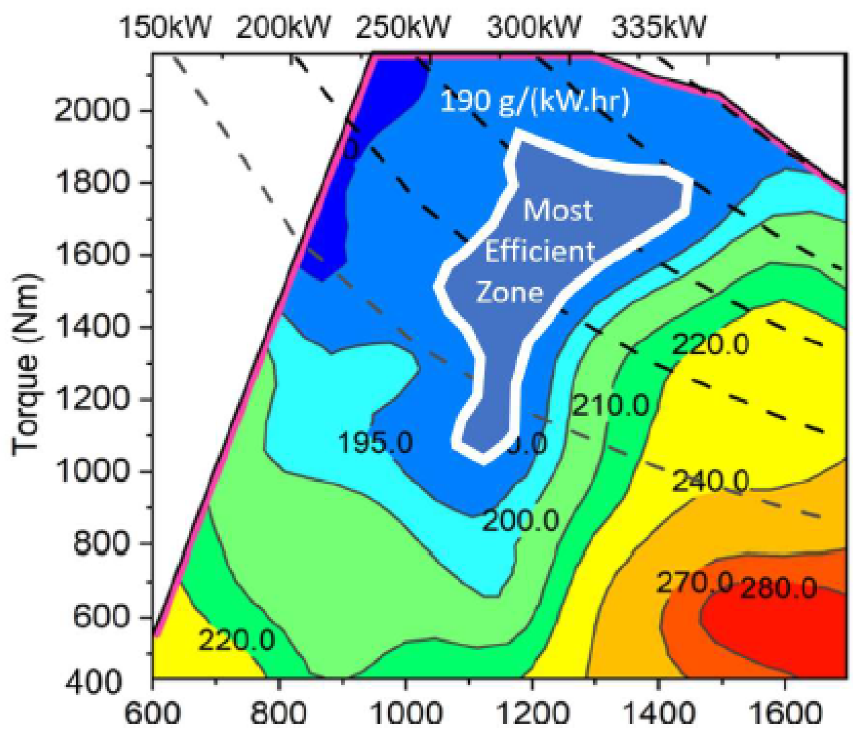
# FINDINGS AND TRIAL LIMITATIONS

**ENGINE SPECIFIC FUEL CONSUMPTION MAP**

Specific fuel consumption is a measure of the amount of fuel consumed by a vehicle for each unit of power output and is measured in units of g/kW•hr. The specific fuel consumption of a truck depends on the engine load and speed.

A brake-specific fuel consumption map was constructed from approximately 3,000 data points. It was determined that the most efficient fuel consumption zone was located to be around 1400-1600 Nm and 1100 rpm.

With the engine operating in this range, the engine has the highest brake thermal efficiency measurements, which produced a specific fuel consumption of 190g/(kW•hr).



# FINDINGS AND TRIAL LIMITATIONS

**PLATOONING FUEL CONSUMPTION**

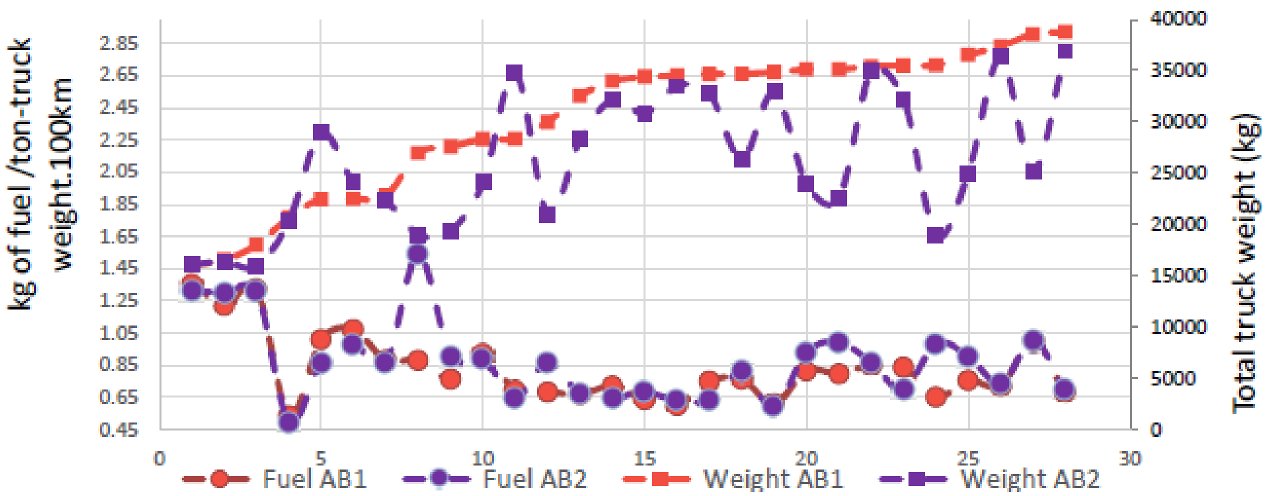
The graph below displays the accumulated fuel consumption of both trucks. Truck weights are a critical factor for specific fuel consumption.

The below trips are sorted based on the ascending weights of the lead truck. Trips where the lead truck had lower weights are displayed on the left side of the graph, and higher load weights are on the right side of the graph.

The follower truck patterns reflect the total vehicle/load weight for each trip

1. When the lead and follower truck have similar weights, fuel consumption is similar.
2. When the lead truck is heavier, the fuel consumption for the lead truck is lower.
3. Trips with empty trailers have higher fuel consumption.

**Data sorted, based on truck weight**




Specific fuel consumption varies from 0.5 to 1.3 kg/ton of over 100 km. For heavier configurations, the specific fuel consumption approached values of 0.65kg/(ton•100km). The average fuel consumptions for these trips ranged from 0.7 to 1.4 kg/ton•100km.

# FINDINGS AND TRIAL LIMITATIONS

### PLATOONING FUEL CONSUMPTION

When there is a substantial weight difference between the lead and follower trucks, the fuel consumption of the heavier truck is lower than the lighter truck

The lead truck consumed more fuel than the follower truck under normal non-platooning conditions. However, when platooning was engaged, the follower truck displayed an increase in fuel consumption when compared to the lead truck. This could be due to the fact that the lead and follower trucks had an average effective distance of over four seconds (i.e., > 100 m) during platooning trips.

Due to this factor, the follower truck experienced an aerodynamic drag reduction. Data confirmed that the power profile and speed profile of the follower truck was not as smooth as the lead truck.

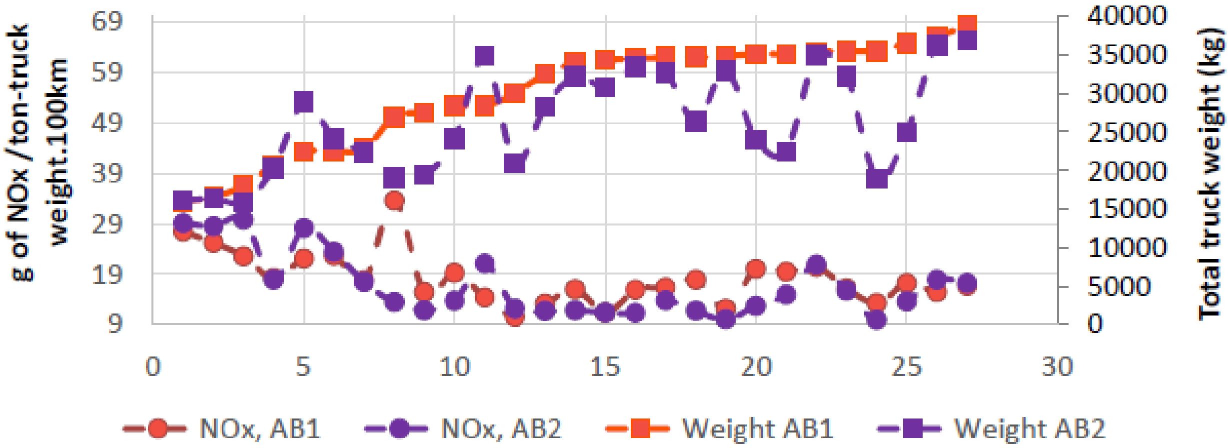
> Engine-optimization is the dominant factor with respect to fuel consumption during platooning. The follower truck typically carried lighter loads and operated furthest outside of the engine optimization range, therefore, generally consuming more fuel than the lead truck during platooning.

Both the lead and follower trucks were equipped with two NOx sensors. The first NOx sensor was located before the after-treatment system that measures engine-out NOx. The second NOx sensor was situated after the exhaust after-treatment system. This sensor measures NOx levels emitted from the tailpipe. Data from both NOx sensors were captured instantaneously during each trial and were measured in ppm.

The after-treatment systems of the two trucks had different conversion efficiencies. The lead truck's after-treatment system demonstrated a stronger conversion efficiency when compared to the follower truck. Because of this factor, comparing tailpipe NOx in platooning trips was too complex and will, therefore, not be presented in this report.

# FINDINGS AND TRIAL LIMITATIONS

### NOX EMISSIONS DATA



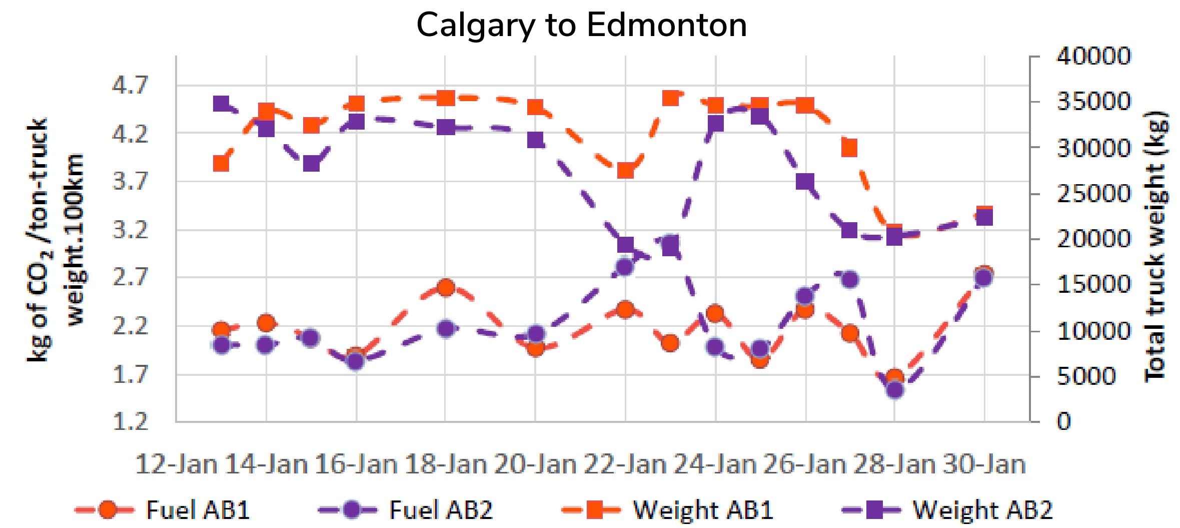

The specific NOx emission and weights of both trucks are shown in the figure above. The trips were sorted based on ascending weights of the lead truck. Trips with an empty trailer produced larger readings of specific NOx. Specific NOx varies from about 10 to 34 g/ton of truck over 100 km. For the heavy configurations, specific NOx gets close to the values of 10 g/(ton•100km).

Specific NOx for the trips from Calgary to Edmonton ranged from 9 to 18 g/(ton•100km), except one trip with 21.2g/(ton•100km). The specific NOx for the trips from Edmonton to Calgary ranged from 13 to 34 g/(ton•100km). Trips from Edmonton to Calgary produced higher specific NOx compared to the reverse path. This could be caused by differences in the engine operating points, since Edmonton's altitude is 378 m less than that of Calgary.

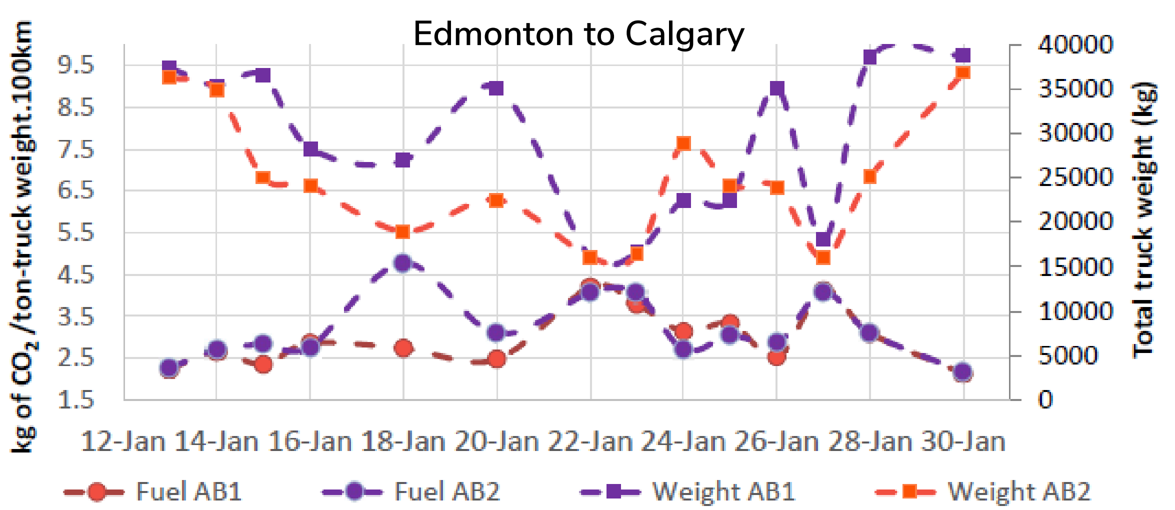
When the weight of the lead and follower trucks were substantially different, it was observed that the lighter truck produced lower specific NOx emissions. Therefore, the weight of the truck was the dominant factor when examining engine-out specific NOx emissions. For trucks with a similar weight, no strong trend was observed for the effect of platooning on NOx emissions.

# FINDINGS AND TRIAL LIMITATIONS

## CO2 AND GREENHOUSE GAS EMISSIONS




Calgary to Edmonton CO2 Emissions ranged from 1.55 - 3 kg/(ton•100km)




Edmonton to Calgary CO2 Emissions ranged from 2.27 - 4.78 kg/(ton•100km)

**CO2 EMISSIONS FROM EDMONTON TO CALGARY WERE GREATER THAN THE EMISSIONS FROM CALGARY TO EDMONTON**

# LESSONS LEARNED

### VEHICLE TECHNOLOGY

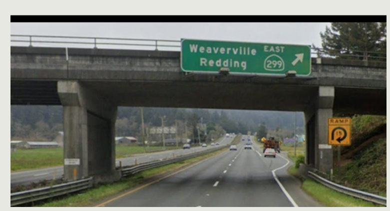
The Cooperative Truck Platooning System (CTPS) trials were conducted between February 2021 and September 2022. This 20-month trial resulted in many successes and lessons learned.

1. Lane-centering assist is a Level 2 autonomous technology that aids the driver to keep the vehicle centered in the lane of travel. Lane-centering is counterintuitive for many drivers, specifically truck drivers, who are trained to position their vehicle slightly to the right of the lane.

2. Well-traveled highways have sections of rutted roads. These deep, narrow trails are located slightly to the right of the lane surface. When rutted roads are encountered, lane-centering technology struggles to travel in the center of the lane and creates an uncomfortable vehicle oscillation.

3. As roads merge, highway markings often "disappear", causing co-pilot and platooning functions to disengage. Drivers must be ready to take over at all times, specifically in situations when absent road-markings occur.

4. There are 13 bridge overpasses on Highway 2. The overpass near Leduc caused the co-pilot and platooning features to disengage. To avoid this anomaly as a trial risk, drivers were instructed to engage and disengage co-pilot and platooning outside of Leduc.



# LESSONS LEARNED

### DATA COLLECTION

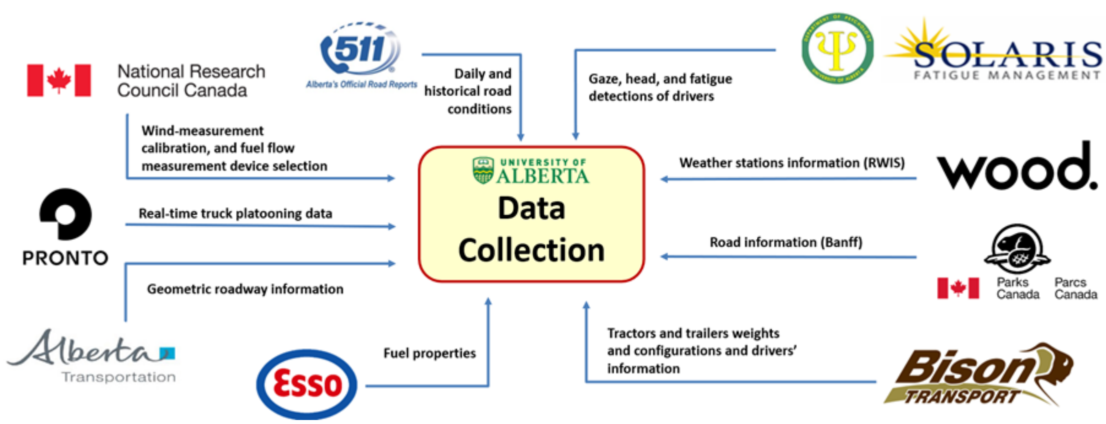
Data collection is critical to the success of a trial. Highly automated, clear, repeatable processes must be developed and followed.

1. The operation of data systems and subsystems needed to be validated before drivers departed at 7:00am. On occasion, researchers were required to meet with the drivers mid-trip in Edmonton to troubleshoot equipment failures or lost data connections.

2. Data equipment was not properly shut down twice during the first week of trials. The data system drained the auxiliary vehicle battery, resulting in the need for an unplanned vehicle boost. Additional training was provided to reduce human error. Turning off the data collection system correctly added additional stress and tasks to the drivers' end-of-day responsibilities.

3. Collecting driver data was more laborious than collecting vehicle data. A researcher was required to calibrate driver-specific equipment in Calgary upon departure and again in Edmonton before drivers began their return trips. COVID-19 illnesses reduced research staff numbers during the trials, making human data collection more challenging than anticipated.

4. A data acquisition (DAQ) system to collect and synchronize trial data was not able to be sourced. A custom unit was developed and designed by Dr. Mahdi Shahbakhti's research team for the CTPS trials.



# LESSONS LEARNED

### CARRIER OPERATIONS

1. Commercial driving is a highly independent career, and drivers are used to working alone. During the CTPS trials, drivers were paired and required to collaborate on departure times as teammates.

2. Inefficiencies were experienced as drivers could not hook up their trailers and go. Drivers were required to wait for whoever took the longest to retrieve/ drop-off their daily loads and connect outside the city limits before starting their routes. Bison adjusted company scheduling to allow for the pick-up and drop-off of freight from a central yard when possible. Drivers were thrilled when yard-to-yard freight pick-up and drop-off was available and disappointed when this task was not removed from their list of trial responsibilities. First- and last-mile delivery extended unpredictable time variables in a driver's day. This resulted in an unanticipated trial variable to consider.

3. Training was provided to each driver scheduled to operate the platooning system. Future studies must consider providing not only training but establishing a level of comfort for each driver interacting with the new technology. As comfort is subjective, varying lengths of vehicle exposure are needed for each individual trial participant.

4. When hauling two trailers, fleets place the heavier trailer in front and the lighter trailer in back. When platooning, this must be reproduced with the heaviest vehicle combination, assuming the lead and the lighter vehicle combination in the following position. Dispatchers were not always aware of this requirement and often assigned the wrong trailer to the lead and follower trucks. Trailer weights and vehicle-positioning require constant monitoring.

5. Public interactions with heavy-duty trucks are surprisingly bold. Although passenger vehicles are closely positioned next to a freight truck, many drivers are fearless and cut immediately in front of a heavy-loaded truck. Trials confirmed that minimizing the gap between two heavy-duty trucks reduces the tendency for passenger vehicles to move between them.

# ADDITONAL INFORMATOIN

**COOPERATIVE TRUCK PLATOONING SYSTEM TRIAL**

For additional trial information, or to receive the detailed Vehicle Analytics or On-Road Driver Experience reports created for the CTPS trials, please visit transformingtransportation.ca or amta.ca.


We would like to extend our thanks to the 100+ project collaborators, including Transport Canada, Alberta Transportation (now TEC), Bison Transport, PMG Technologies, Pronto, Solaris Fatigue Management, Tantus, University of Alberta Vehicle Analytic team, Driver Experience team and Traffic Interaction team, and project sponsor Esso.