Key Questions

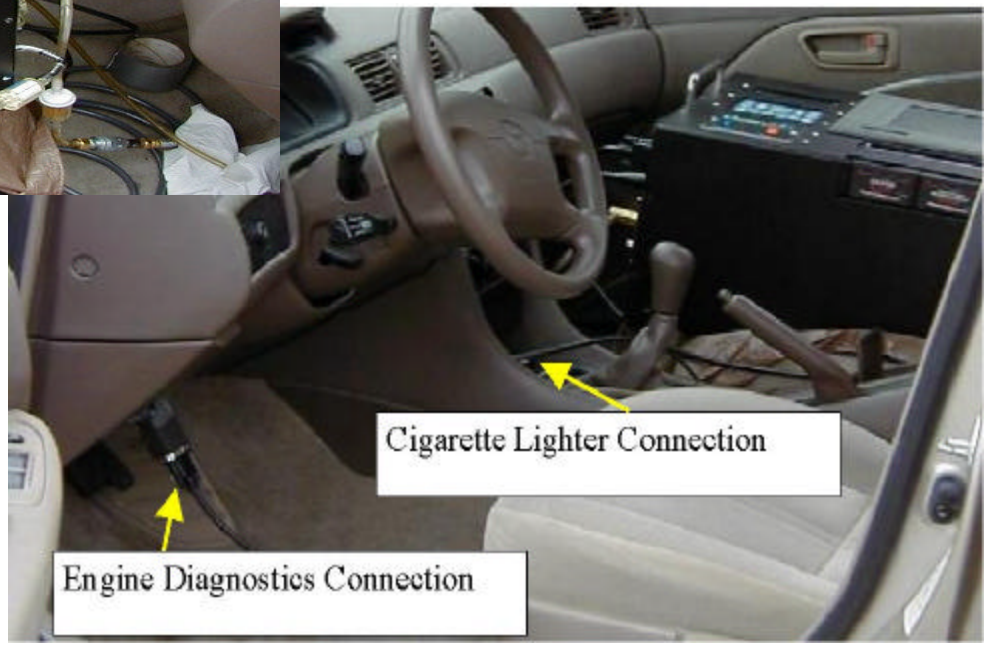
(1) How can we efficiently and flexibly measure real-world, on-road vehicle emissions along a route?

(2) What are the on-road vehicle emissions during each driving mode (deceleration, acceleration, idle, cruise)?

(3) How are on-road vehicle emissions affected by delay caused by traffic signals?

(1) On-Board Emission Measurement (OEM 2100)

OEM 2100 Installed in Passenger Seat



OEM 2100 Internal Connections

On-Board Emission Measurement (OEM 2100)

Emissions Sampling Probe Inserted into Tailpipe

Vehicle Fully Equipped and Ready for Testing

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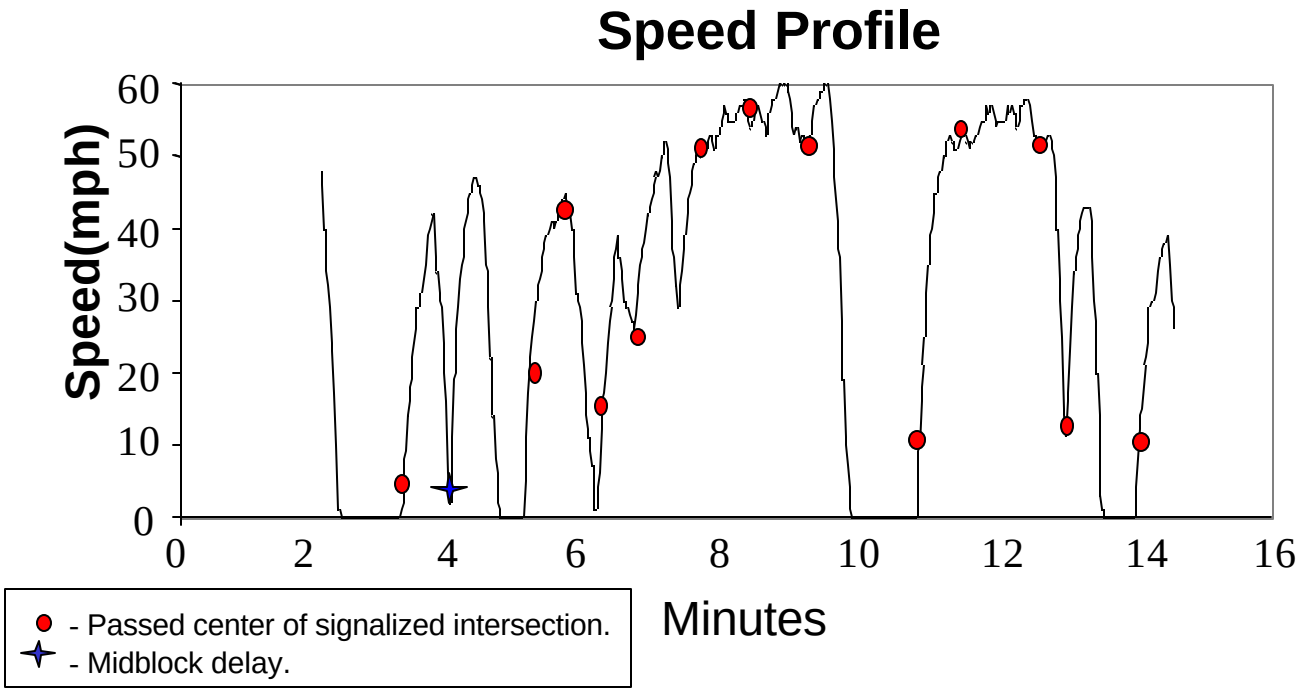
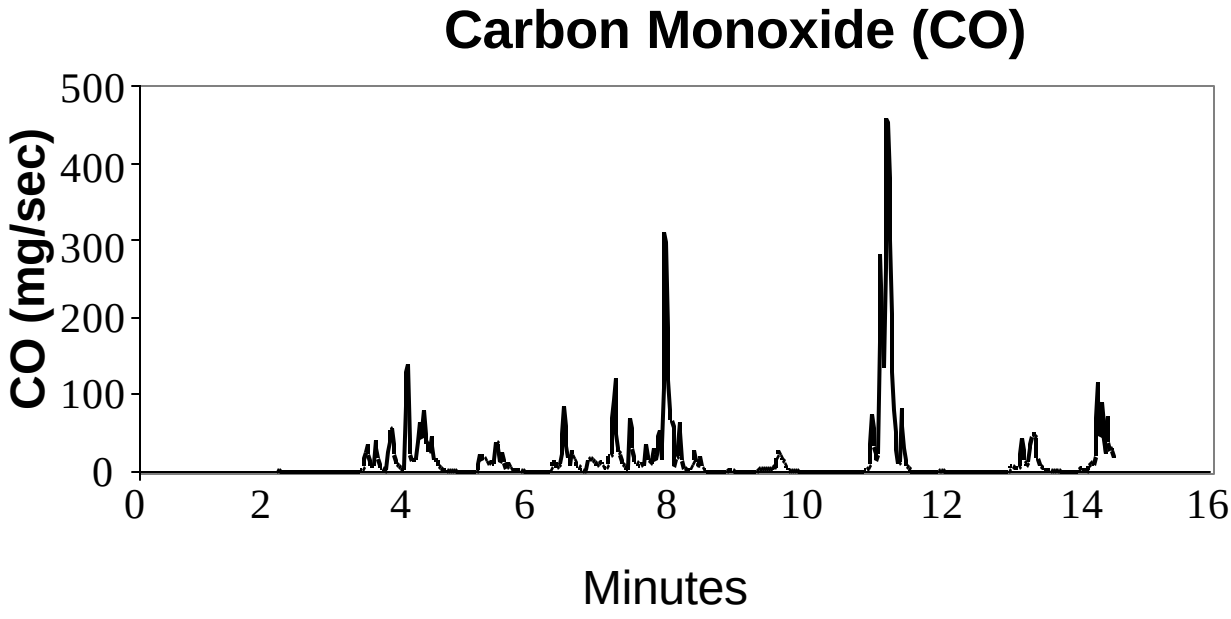
Description of OEM 2100

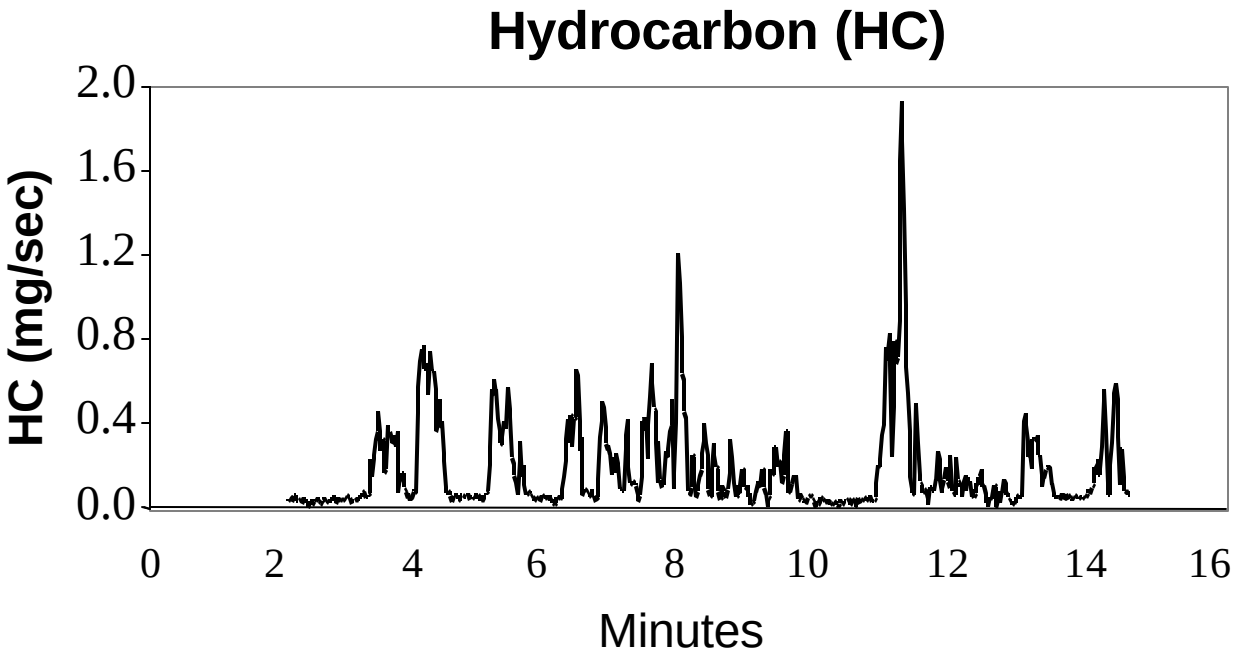
- Equipment can be set up in 15 minutes.
- Connections are fully reversible, with no modification to the vehicle.
- Measures HC, NO, CO, and CO_2 concentrations from tailpipe exhaust.
- Measures engine diagnostics, such as vehicle speed and engine RPM, from On-Board Diagnostic (OBD) link.

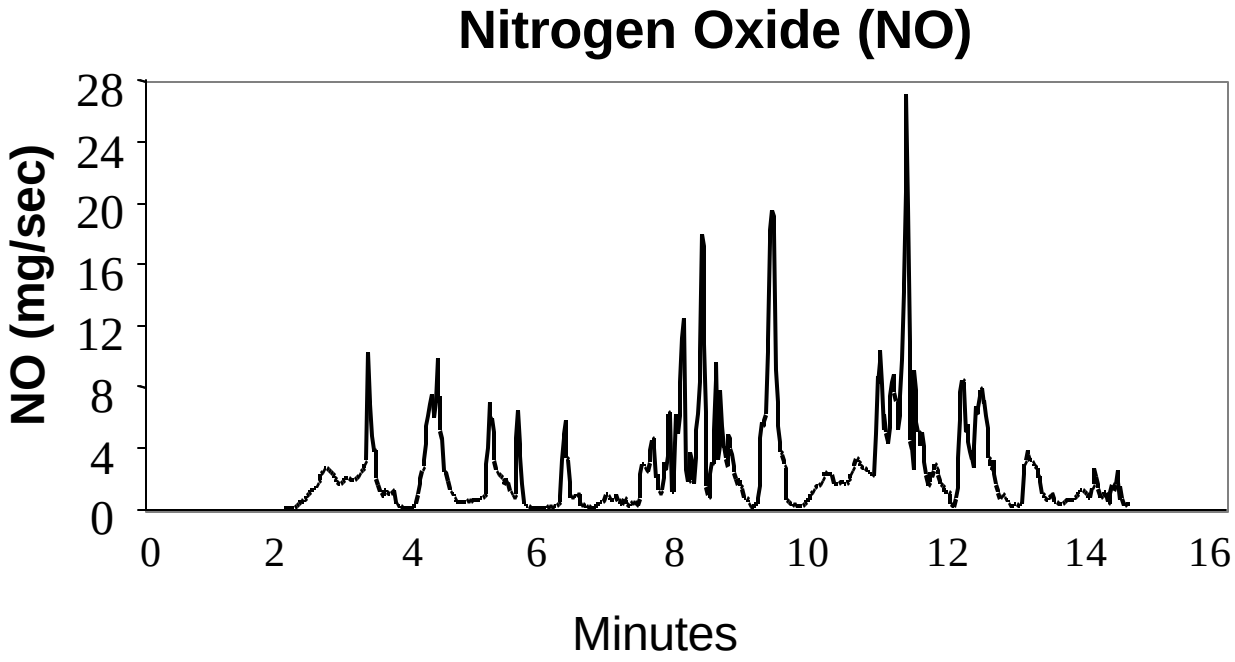
Example Speed and Emission Profile





Vehicle: 1996 Oldsmobile Cutlass.

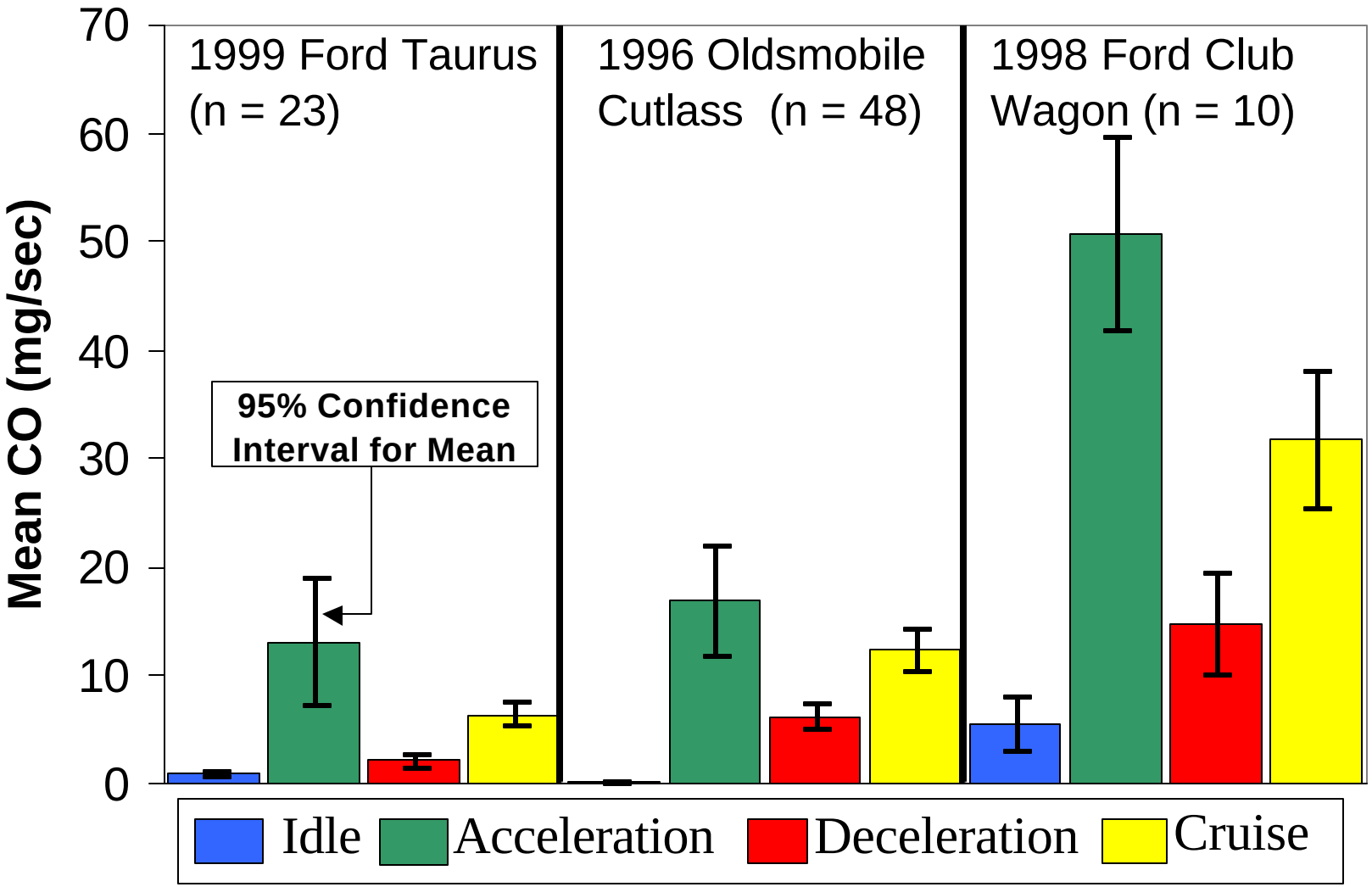




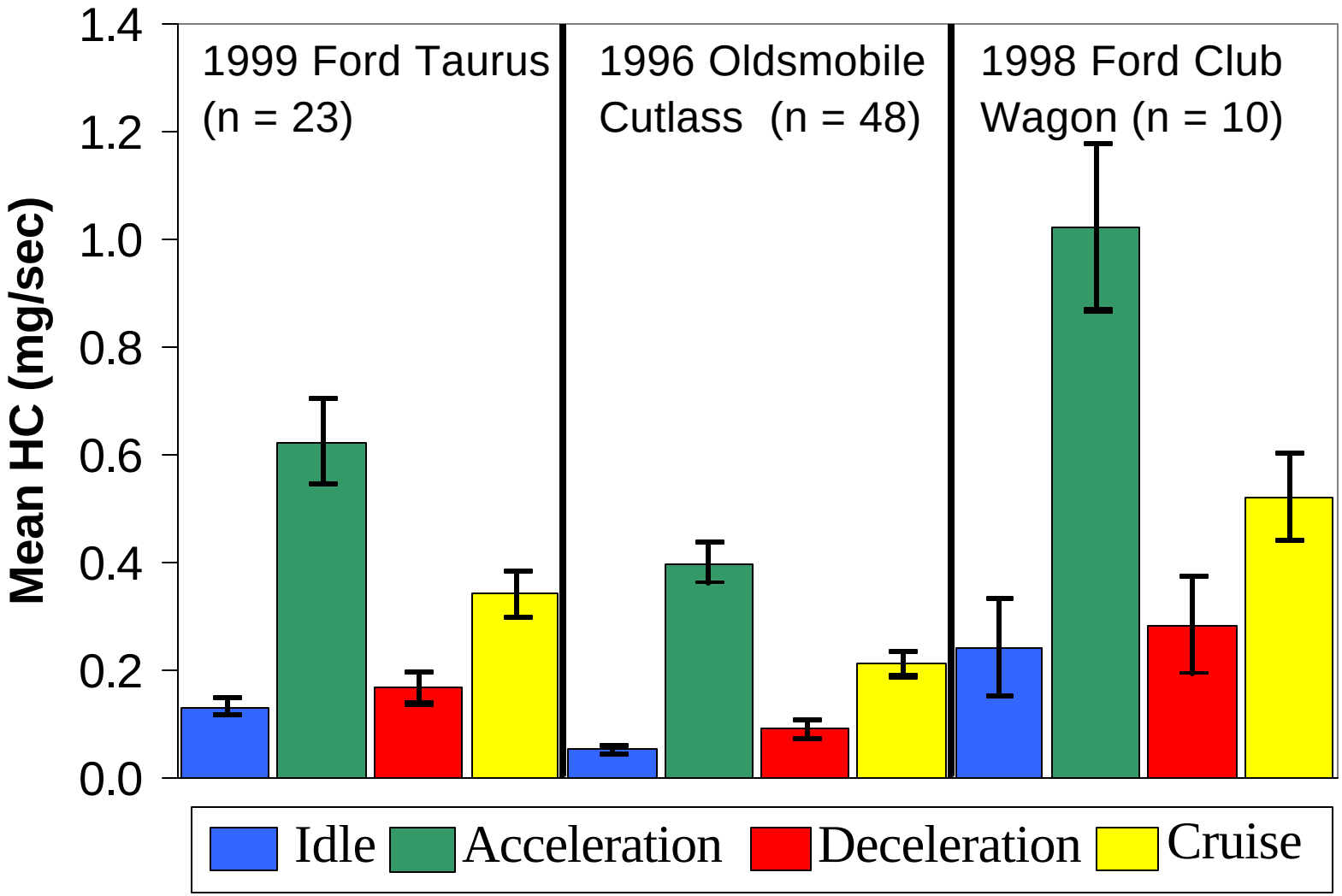
Emissions Occur in Short Episodes Concurrent with Acceleration Events During This Run.

Vehicle: 1996 Oldsmobile Cutlass.

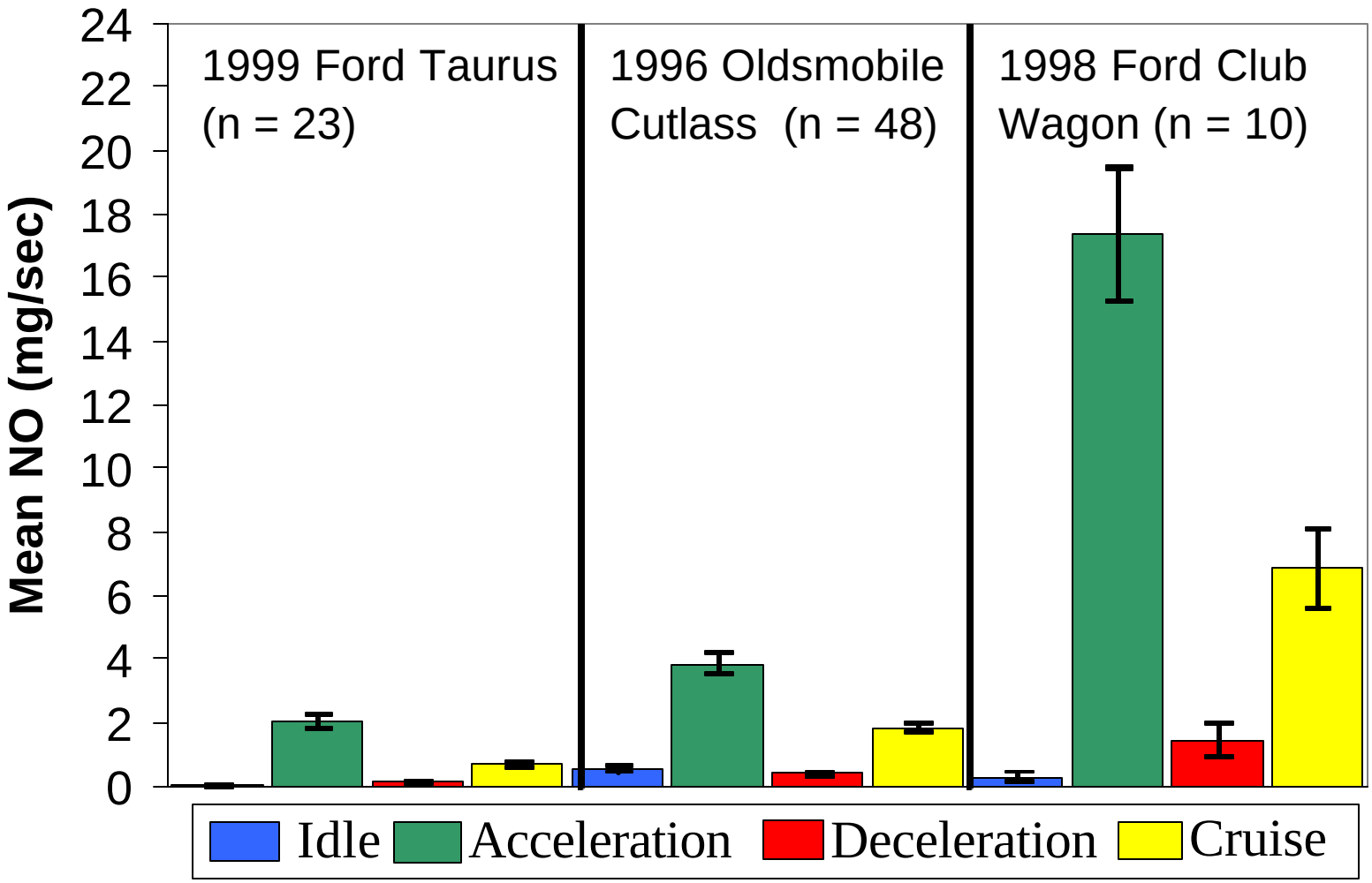
(2) CO Emissions by Driving Mode



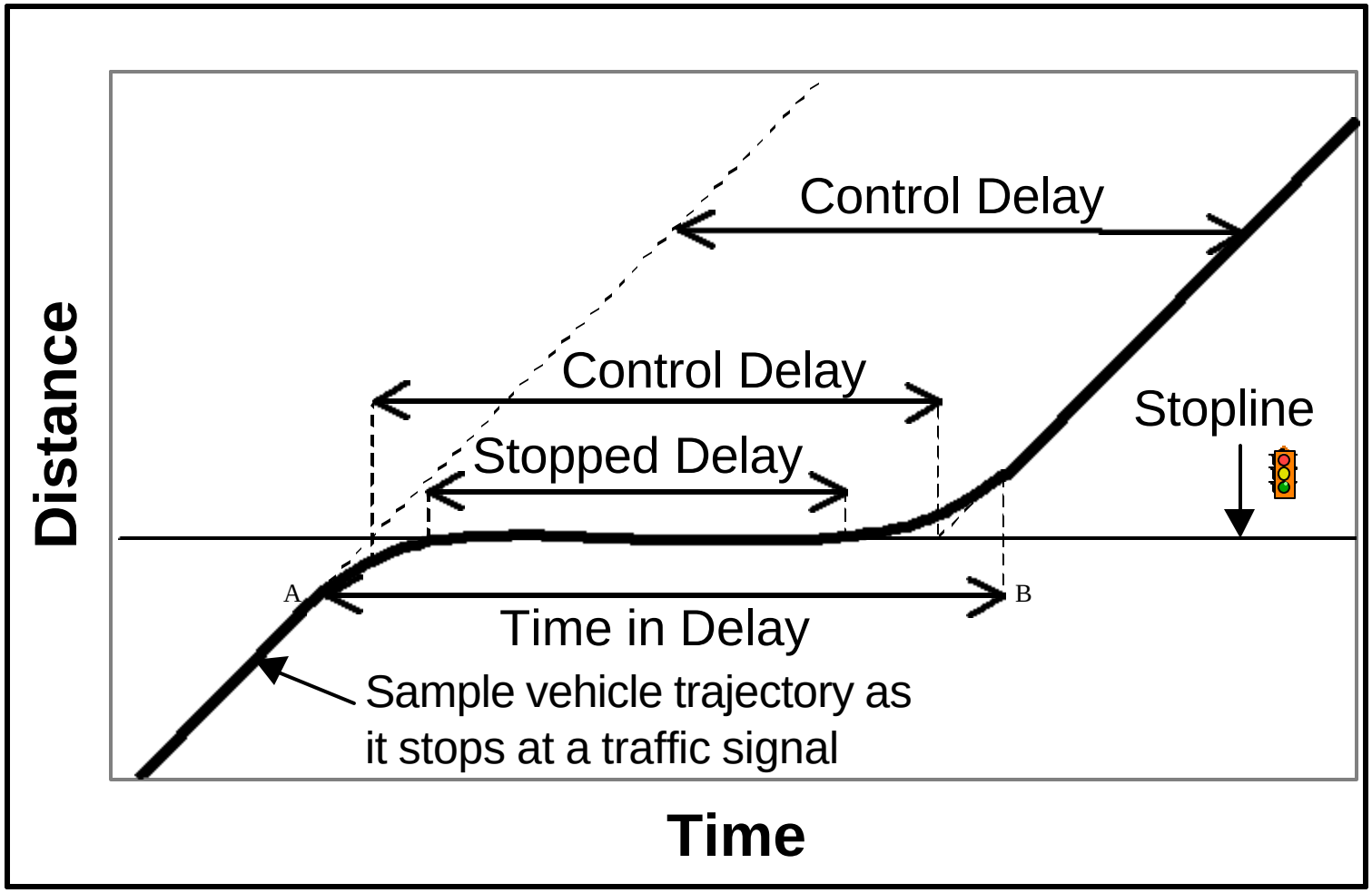
HC Emissions by Driving Mode



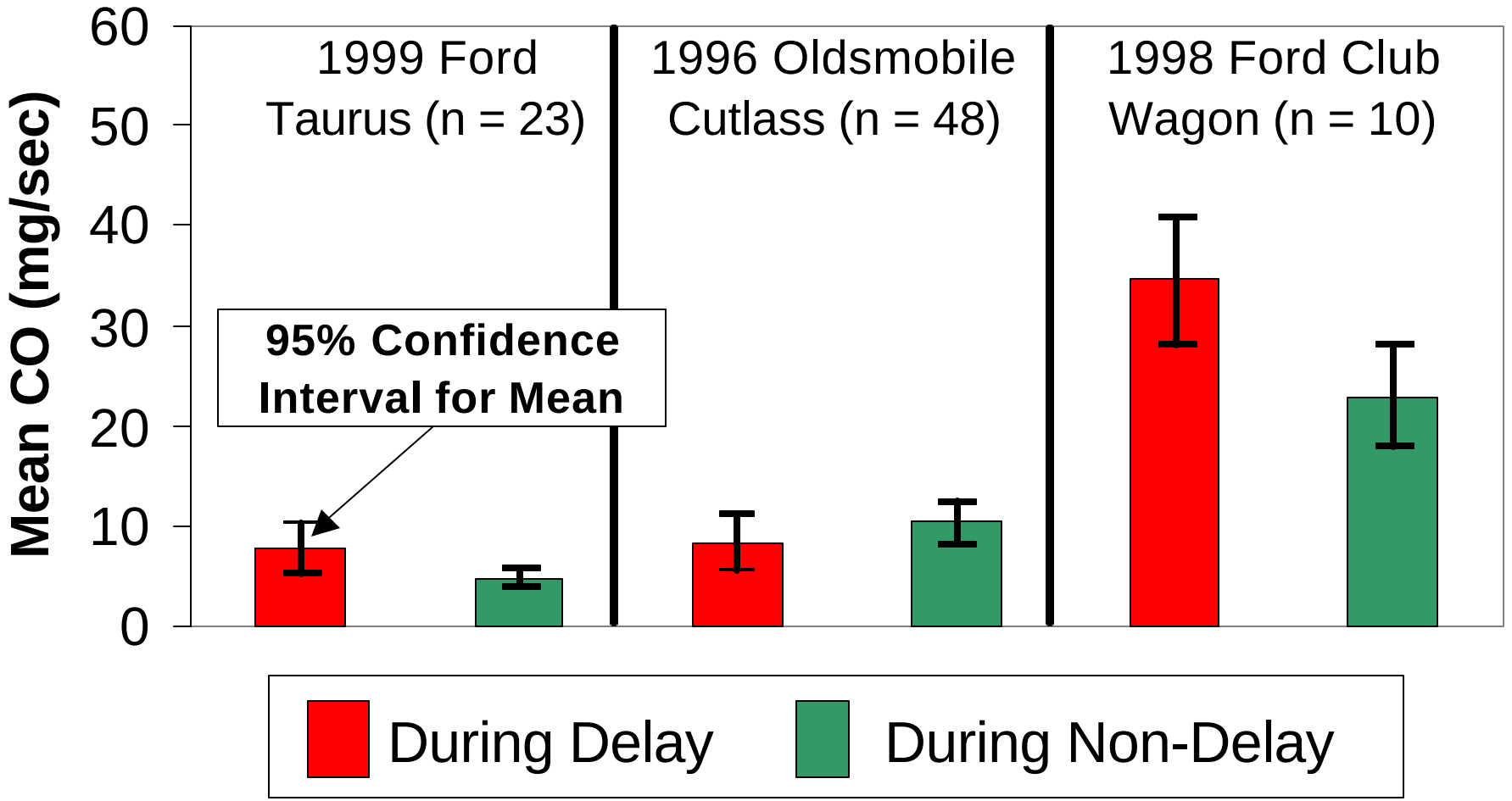
NO Emissions by Driving Mode



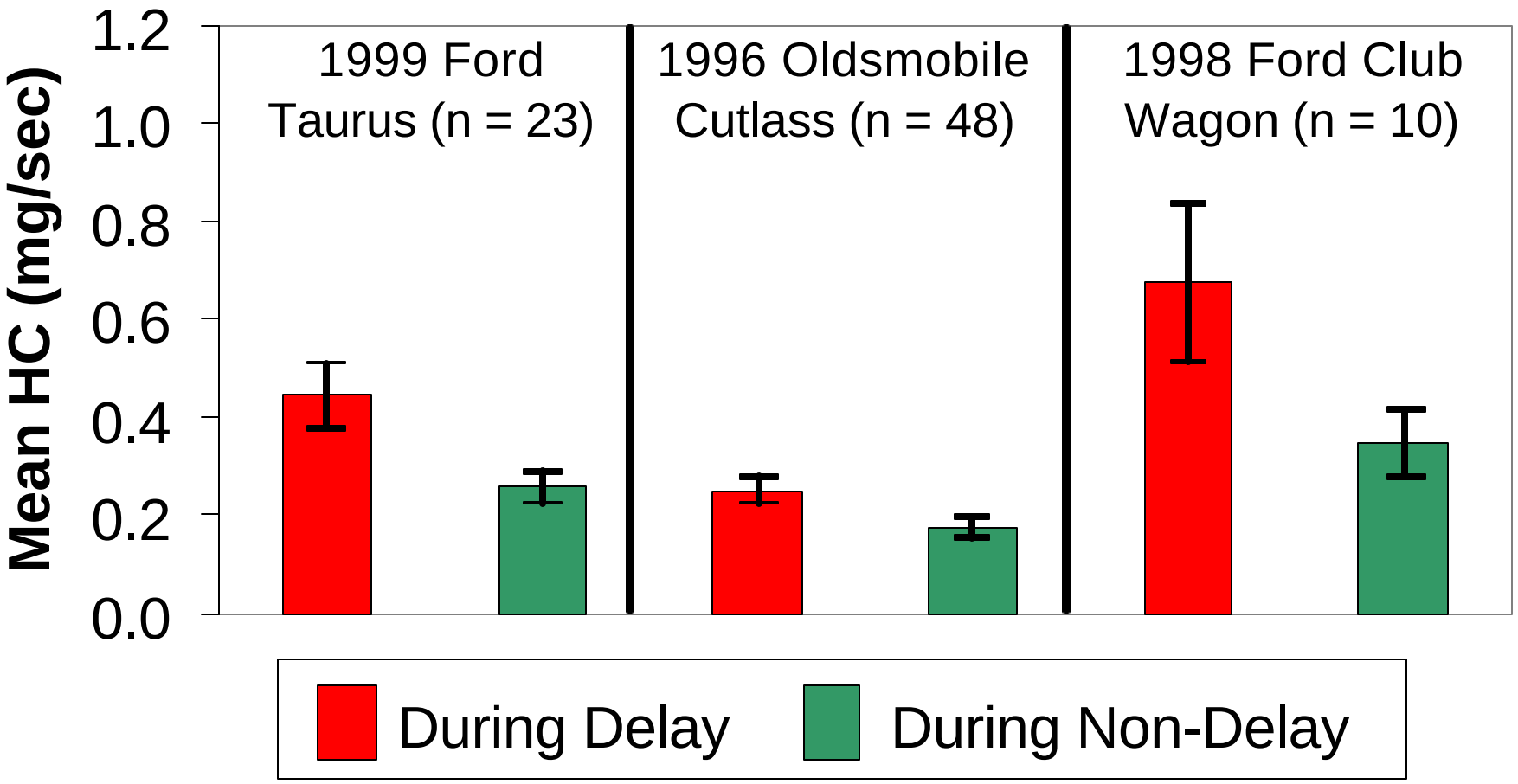
(3) Effect of Traffic Signal on Intersection Delay



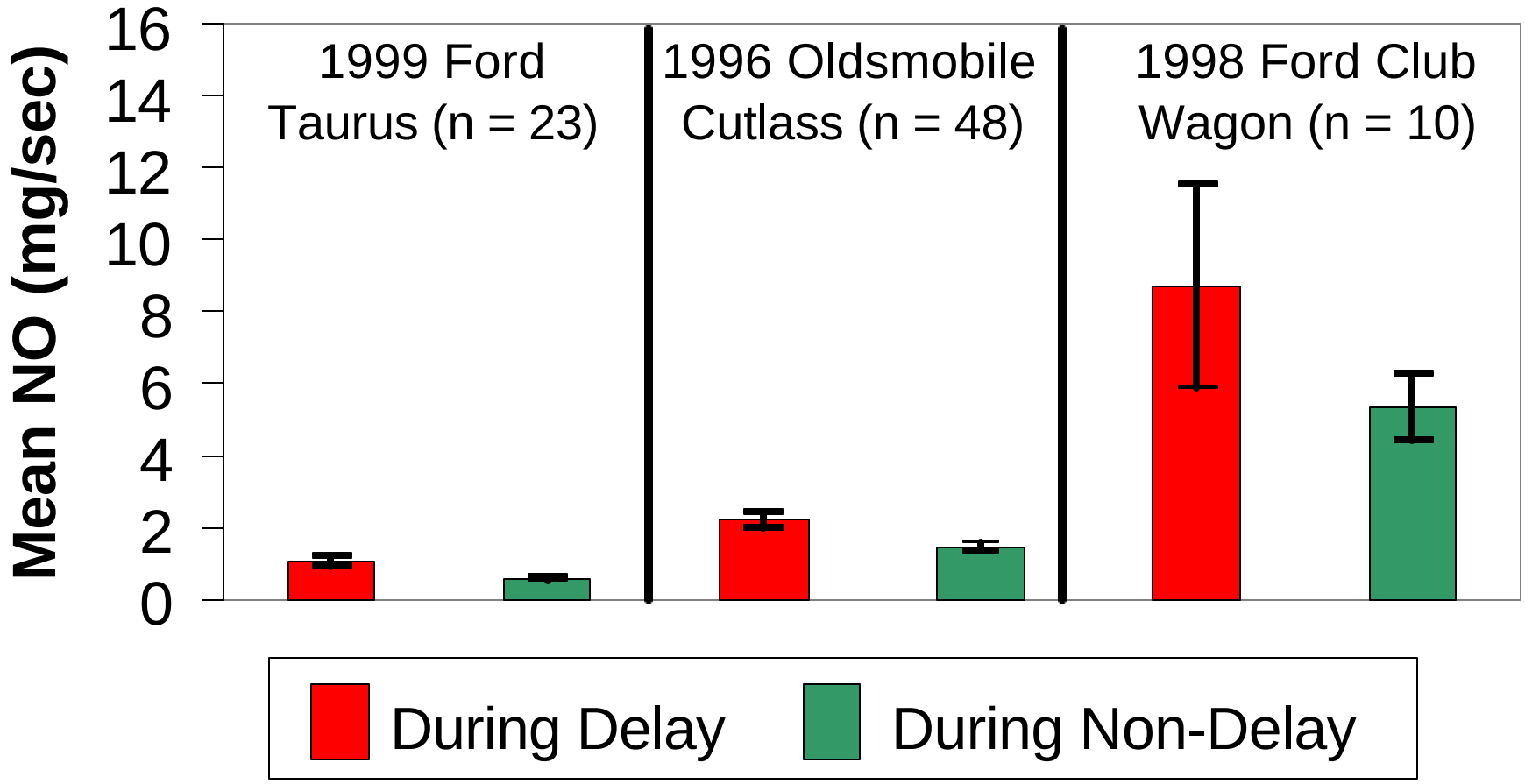
CO Emissions by Delay Status



HC Emissions by Delay Status



NO Emissions by Delay Status



Answer to Question 1

- OEM 2100 allows real-world, on-road vehicle emissions measurements on any route.
- OEM 2100 yields simultaneous measurement of vehicle emissions and engine data on a second-by-second basis.
- Data from OEM-2100 allow direct investigation between emissions and traffic control.

Answer to Question 2

- Vehicle emissions are highest during the acceleration mode for all vehicles studied.
- Therefore, emissions are more sensitive to the number of stops than to the duration of each stop.
- Vehicle emissions are lowest during the idling mode for all vehicles studied.

Answer to Question 3

- Vehicle emissions are higher during delay than during other portions of an arterial trip.
- Higher emissions during delay are because of accelerations not idling.
- Signal systems should be designed to minimize stops to reduce vehicle emissions.
- Reducing number of stops will also reduce number of accelerations, thereby reducing emissions.

Future Work

- Investigate effect of other traffic measures (e.g., number of stops) on vehicle emissions.
- Investigate effect of signal coordination on vehicle emissions.
- Test additional vehicles on signalized arterials during different congestion levels.

Acknowledgements

- Sponsored by North Carolina Department of Transportation (NCDOT) via the Center for Transportation and the Environment (CTE)

- Clean Air Technologies, International - Developer of OEM 2100

- For more information, visit: www4.ncsu.edu/~frey/emissions/

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