An Improved Method for Determining the Real-World Impacts of Vehicle Fuel Efficiency Technologies

MESILLA VALLEY TRANSPORTATION SOLUTIONS | *FUEL ECONOMY EXPERTS*

18 Years Experience: Motorsports, Testing, Advanced R&D

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Racing → Trucking

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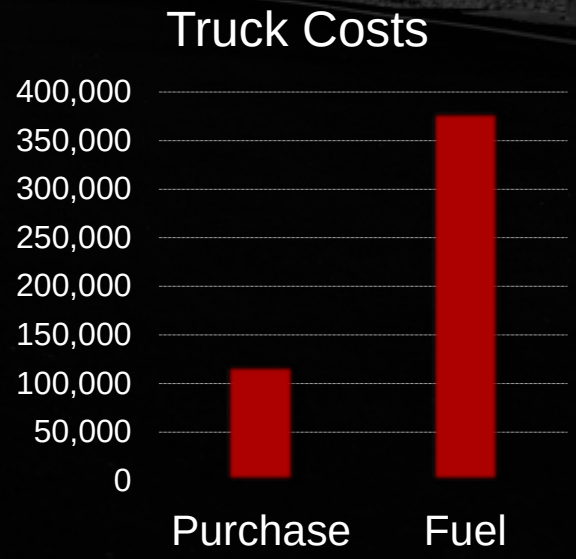
Importance of Fuel Economy

	Purchase	Fuel Over Lifetime
Cost	**$120,000**	**$379,000**



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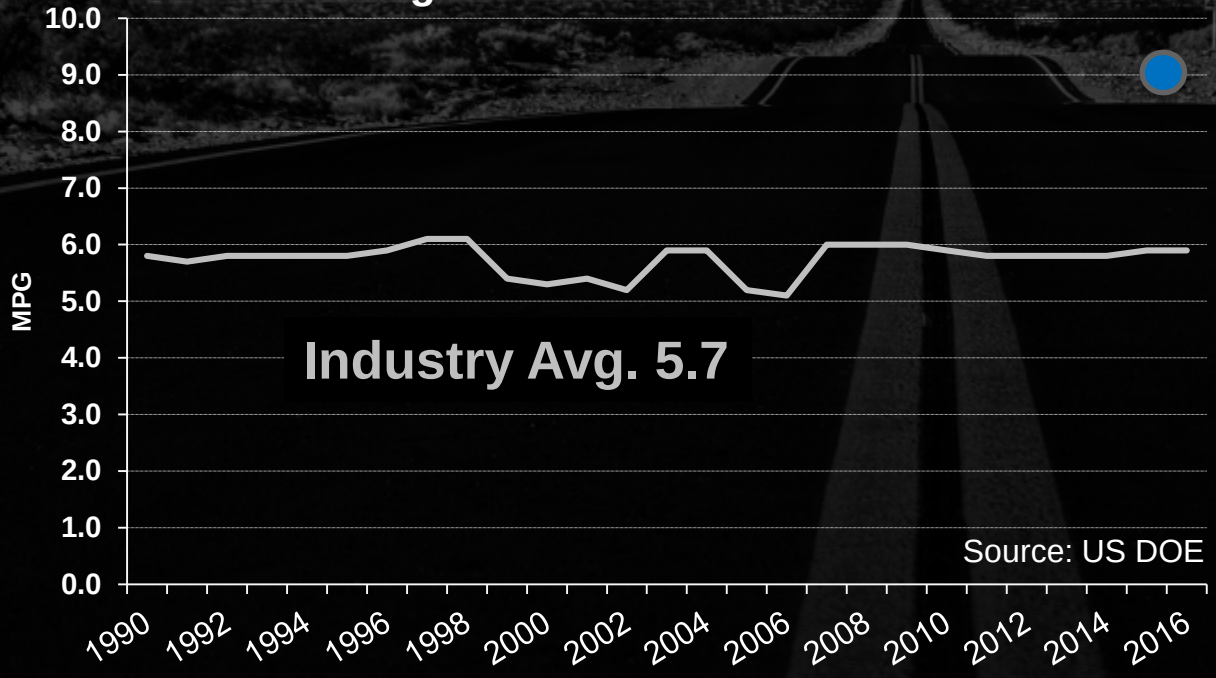
Fuel Economy in Trucking

- 12.0 MVT Top Driver
- 9.0 MVT Fleet Avg.

Fuel Mileage 1990 – 2016 Class 7-8 Vehicles



Barriers to Improving Fuel Economy

2013 Study with NACFE, CSS, ICCT
The five predominant barriers are:

1) Lack of credible information

2) Uncertainty around the amount of time needed for technologies to pay for themselves in terms of fuel savings (i.e. payback time)…

2013 Smartway Presentation

- Market confusion due to lack of understanding and claims

- Translating standardized testing to performance and ROI for a given fleet

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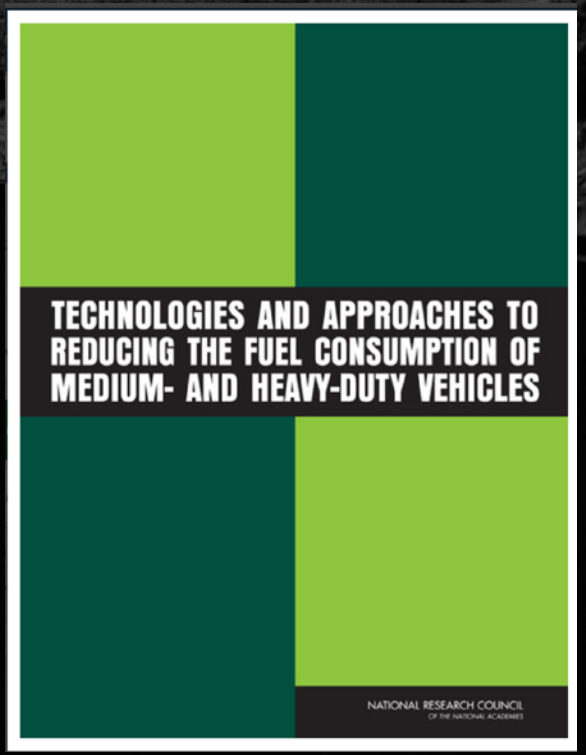
Due to Unreliable Testing

National Academies Press, 2010
Finding 2.5

…accurate test procedures are required to reliably determine the potential benefit of technologies that reduce fuel consumption. Unfortunately, it is very difficult to achieve, at the 90 or 95 percent confidence interval, a precision of less than ±2 percent for vehicle fuel consumption measurements with the current SAE test procedures.



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21ST CENTURY:
HIGH TECH FUEL ECONOMY TESTING

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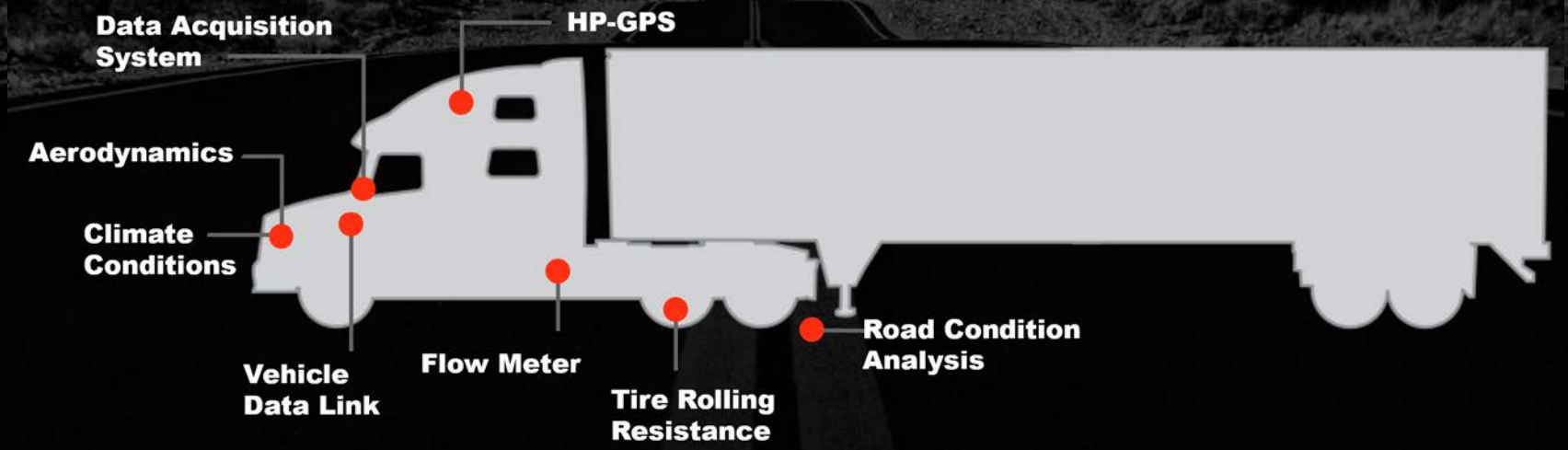
How We Test: Sensors, Data, Analytics



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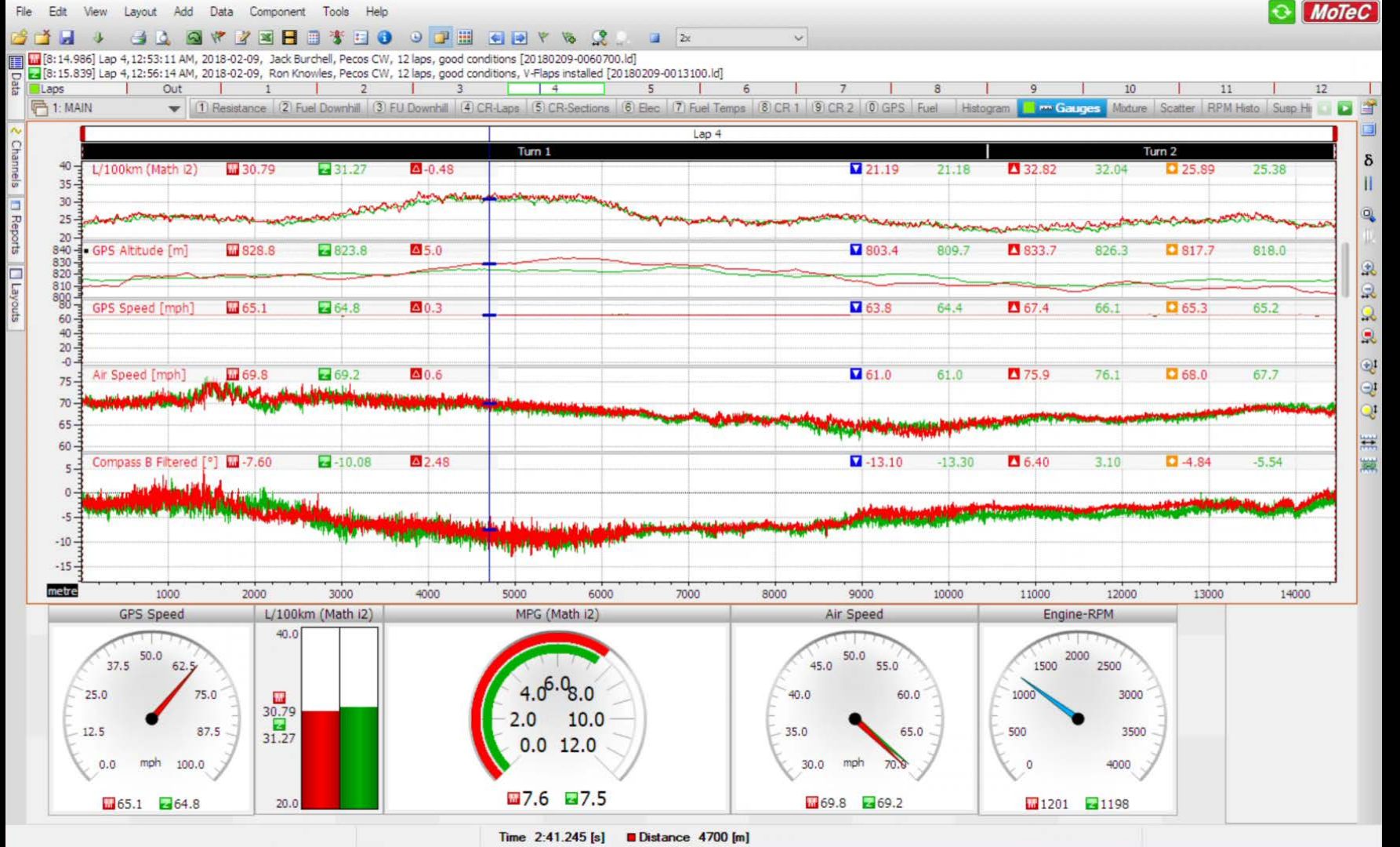
Data is Limitless and Critical

- **Fuel consumption**
- **Air speed, direction**
- **Driver behavior**
- **Rolling resistance**
- **…….Limitless**


File Edit View Layout Add Data Component Tools Help
MoTeC
[8:14.986] Lap 4, 12:53:11 AM, 2018-02-09, Jack Burchell, Pecos CW, 12 laps, good conditions [20180209-0060700.ld]
[8:15.839] Lap 4, 12:56:14 AM, 2018-02-09, Ron Knowles, Pecos CW, 12 laps, good conditions, V-Flaps installed [20180209-0013100.ld]
Laps
1: MAIN
Resistance
Fuel Downhill
FU Downhill
CR-Laps
CR-Sections
Elec
Fuel Temps
CR 1
CR 2
GPS
Fuel
Histogram
Gauges
Mixture
Scatter
RPM Histo
Lap 4
Turn 1
Turn 2
L/100km (Math i2) 30.79 31.27 -0.48 21.19 21.18 32.82 32.04 25.89 25.38
GPS Altitude [m] 828.8 823.8 5.0 803.4 809.7 833.7 826.3 817.7 818.0
GPS Speed [mph] 65.1 64.8 0.3 63.8 64.4 67.4 66.1 65.3 65.2
Air Speed [mph] 69.8 69.2 0.6 61.0 61.0 75.9 76.1 68.0 67.7
Compass B Filtered [°] -7.60 -10.08 2.48 -13.10 -13.30 6.40 3.10 -4.84 -5.54
metre
GPS Speed
mph
65.1 64.8
L/100km (Math i2)
30.79 31.27
MPG (Math i2)
7.6 7.5
Air Speed
mph
69.8 69.2
Engine-RPM
1201 1198
Time 2:41.245 [s]
Distance 4700 [m]

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Analytics: Energy Method Fuel Consumption (Patent Pending)

$E=mc^2$

1st Principle of Thermodynamics

$E_{IN} = E_{OUT}$

$E_{IN} = E_{FUEL}$

E_{OUT} = Measured/Calculated = Energy from variables: Aerodynamics, Rolling Resistance, Acceleration….

$E_{FUEL} = E_{AERO} + E_{ROLL} + E_{ACCEL.} + E_{AUXILIARY} + E_{HEAT} + \ldots\ldots\ldots$

Energy Method Fuel Consumption

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Example Test: Vented Mud Flap

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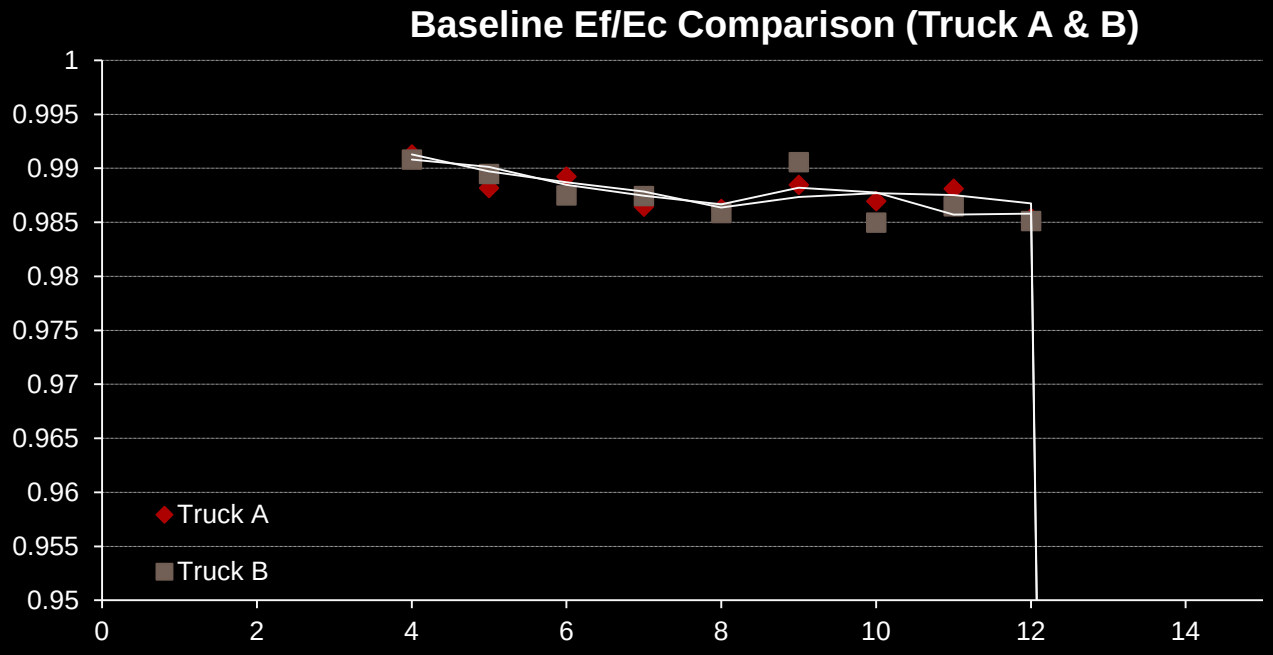
Analytics: Ef / Ec Ratio



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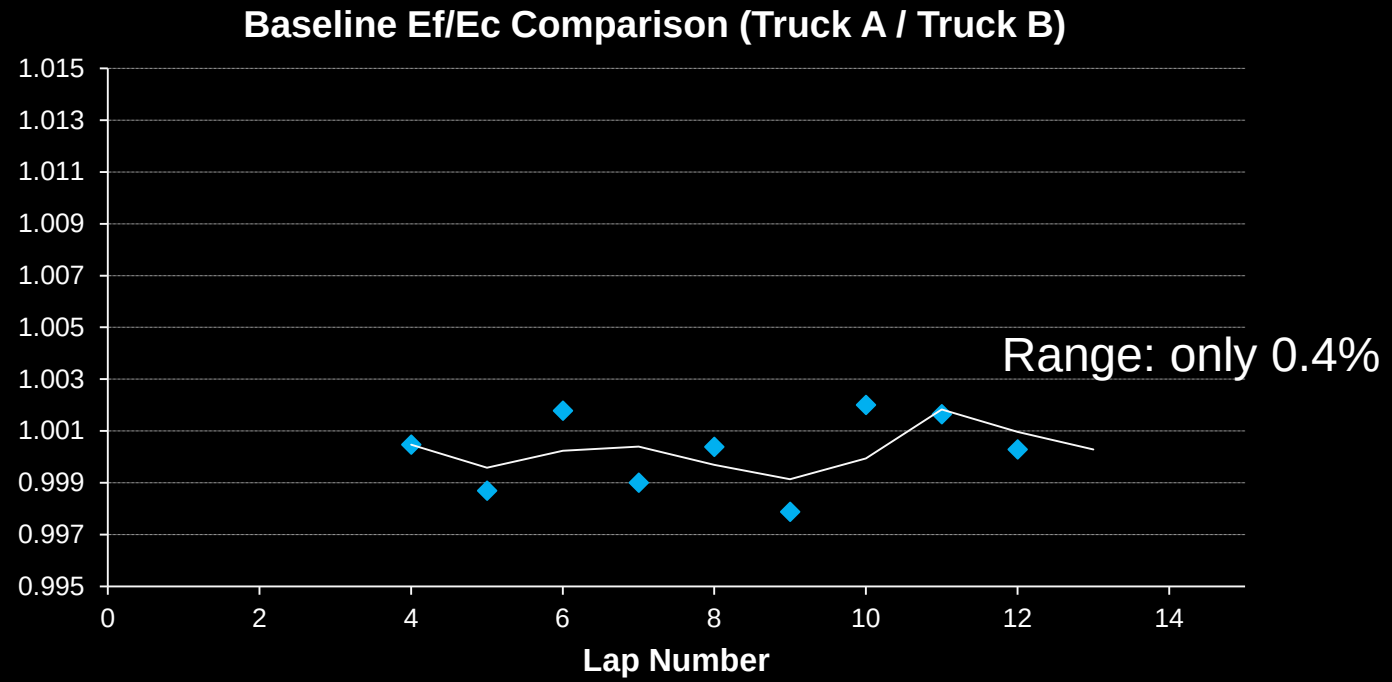
Calculations: Ef / Ec Ratio



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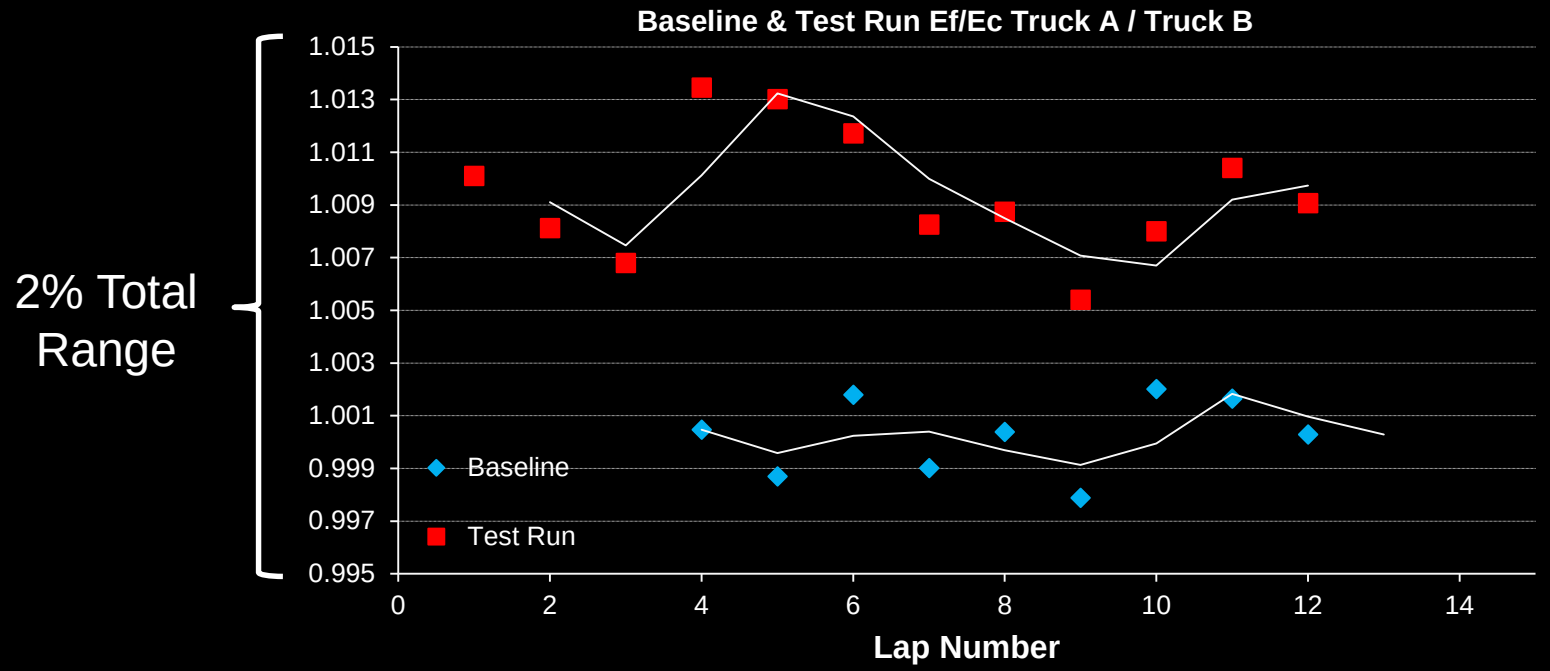

2% Total Range

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Example Test: Vented Mud Flap

	Test Results: Improvement		
	gal/1000 miles	MPG	Percent
Average	**1.01**	0.09	0.93%
Accuracy	**+/- 0.30**	+/- 0.03	+/- 0.27%

MVTS Test = Reliable decision = $325,000 annual fuel saved in MVT fleet

SAE J1321 Test = Within margin of error = Unreliable = No decision = $0 fuel saved

MVTS Test Specs

		MESILLA VALLEY TRANSPORTATION SOLUTIONS
Accuracy		+/- 0.2 to 1.0%
Variables Accounted For	Wind	✓
	Temperature	✓
	Driver Behavior	✓
	Fleet Duty Cycle	✓
	Weight (GVW)	✓
	Vehicle Specs (tires, aero, etc.)	✓
	Fleet Climate	✓
Real-World Prediction		✓
Time		2-4 hours
Distance		100 - 300 miles
Cost		Avg. $12,000
Ease to Conduct		Very easy when trained
Payback		0.1 months

SAE J1321

Since 1986: Old methods rely on old technology

- FUEL TANK
- SCALE
- MINIMAL DATA

MVTS vs. SAE J1321

		MESILLA VALLEY TRANSPORTATION SOLUTIONS	SAE J1321
Accuracy		+/- 0.2 to 1.0%	+/- 1.0 to 5.0%
Variables Accounted For	Wind	✓	✗
	Temperature	✓	✗
	Driver Behavior	✓	✗
	Fleet Duty Cycle	✓	✗
	Weight (GVW)	✓	✗
	Vehicle Specs (tires, aero, etc.)	✓	✗
	Fleet Climate	✓	✗
Real-World Prediction		✓	✗
Time		2-4 hours	1 - 3 days
Distance		100 - 300 miles	300 - 1000 miles
Cost		Avg. $12,000	Avg. $40,000
Ease to Conduct		Very easy when trained	Difficult, complex due to labor and procedures
Payback		0.1 months	24 - 48 months

Call to Action & Responsibility

Make Better Testing the Industry Standard –Help Everyone Improve

- Regulatory organizations –let's talk
- Testing companies –let's talk

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MVTS: Real-World Prediction

MVTS Test Result → Climate 'Normalized' → Fleet's Duty Cycle

- X.x Fuel Savings
- Aerodynamics
- Tires
- Engine
- Drivetrain

- Temperature
- Altitude
- Wind

- Speed Brackets
- Distance travelled
- Fuel economy
- Driver behavior
- Vehicle Spec's

Decisions: Fast, Cost-effective, Easy

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How We Test: Sensors, Data, Analytics

Aerodynamic sensors:

- Wind speed
- Wind direction
- Air pressure
- Air temperature

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How We Test: Sensors, Data, Analytics

Fuel Flow Meter:

- Fuel consumption, precise to 0.2%
- Temperature compensated
- …and many more sensors

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How We Test: Sensors, Data, Analytics

Data Acquisition:

- Racing-inspired
- High resolution/sampling
- Customizable