

Partnering with Industry to Advance Green Fleet Technologies

Northeast and Midwest Joint Equipment Management
Meeting
Ron Schoon
June 24, 2013

NREL's Mission

“NREL develops renewable energy and energy efficiency technologies and practices, advances related science and engineering, and transfers knowledge and innovations to address the nation's energy and environmental goals.”

Dr. Dan Arvizu



NREL R&D Locations

South Table Mountain



“Main Site”

National Wind Technology Center



“Wind Site”

Laboratory Snapshot

Only National Laboratory Dedicated Solely to Energy Efficiency and Renewable Energy

- Leading clean-energy innovation for 34 years
- 1740 employees with world-class facilities
 - Another 500 students, contractors, etc
 - Employees from 70 different countries
- Annual budget ~ \$312M
- Campus is a living model of sustainable energy
- Owned by the U.S. Department of Energy
- Operated by the Alliance for Sustainable Energy LLC



Scope of NREL's Mission



Energy Efficiency

Residential Buildings

Commercial Buildings

Personal and Commercial Vehicles



Renewable Energy

Solar

Wind and Water

Biofuels

Hydrogen

Geothermal

Fuels & Vehicles-Related Technologies



Electricity Integration

Grid Infrastructure

Distributed Energy

Interconnection

Battery and Thermal Storage

Electric Transportation



Market Focus

Private Industry

Federal Agencies

Defense Dept

State/Local Govt

International

Underpinned with Basic Science Research

Photoconversion

Computational Science

Systems Biology

Focusing NREL's Roles on "Systems"



Community and Industrial Systems

Integrated and Sustainable



The Built Environment

Highly Efficient • Uses Renewables



Electricity Generation Systems

Distributed and Utility-Scale Renewable Power



Sustainable Electricity System



Transportation Systems

Highly Efficient • Fuel Flexible

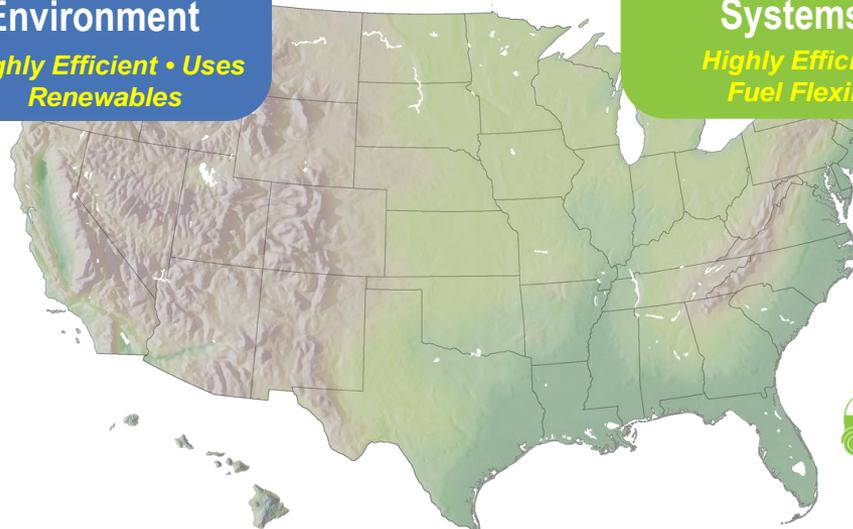


Fuel Production Systems

Use RE Resources



Sustainable Transportation System



NREL Philosophy → Partnerships

- NREL has more than 300 active partnering agreements*
- Roughly 50% our Cooperative R&D Agreements (CRADAs) are with small businesses and 25% with large businesses
- More than 40% of our Work for Others (WFO) agreements are with Federal, State or local governments and 25% are with businesses



* As of 2011 fiscal yearend

NREL's Sites – Leading by Example

- **NREL Onsite Renewable Electricity** -- PV > 4 MW, Wind > 5 MW



Renewable Fuel Heating Plant
-- displaces 70% of natural gas use

Science and Technology Facility
-- first U.S. Federal LEED Platinum building



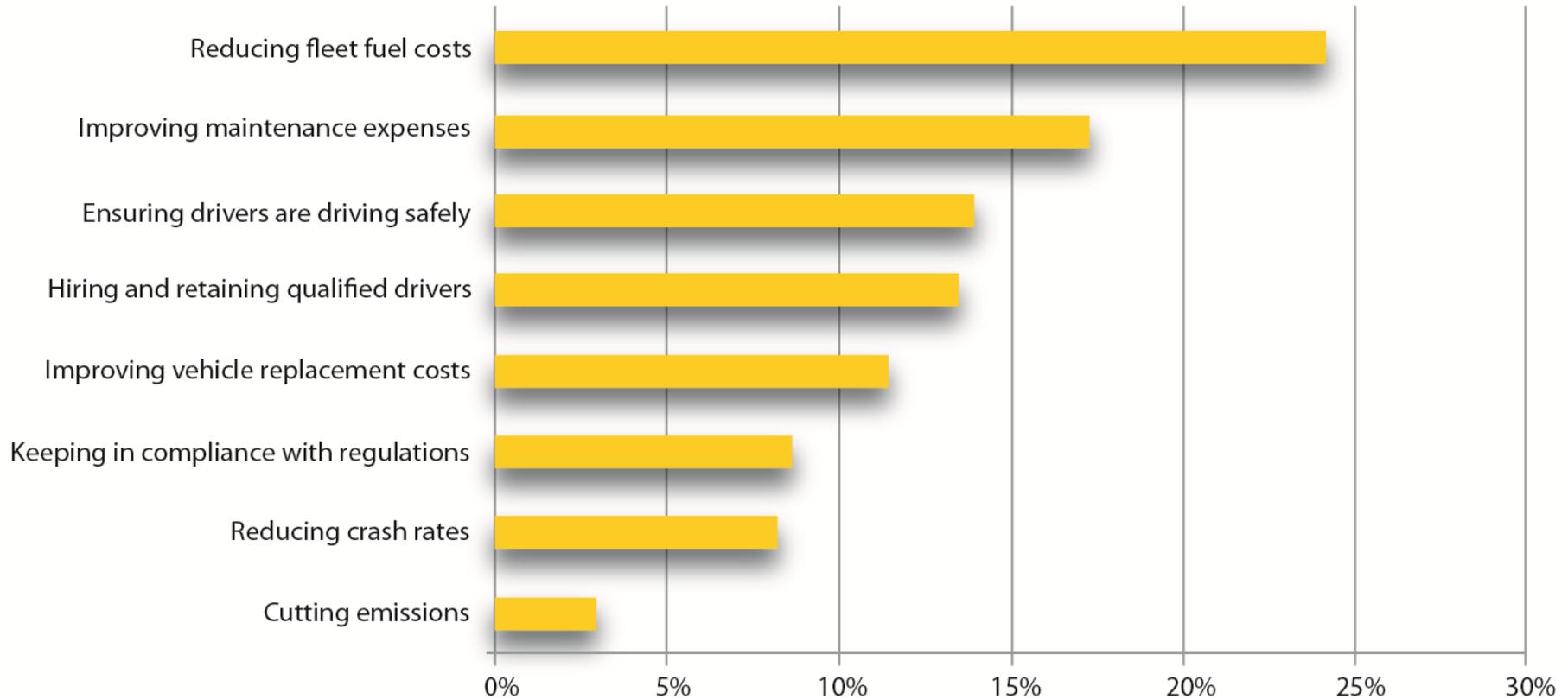
Vehicle Fleet -- >75% alternatively fueled

Research Support Facility
– net-zero energy (1,250 personnel in 330,000 ft²)



Setting Priorities and Overcoming Challenges

Most Important Challenge for 2013



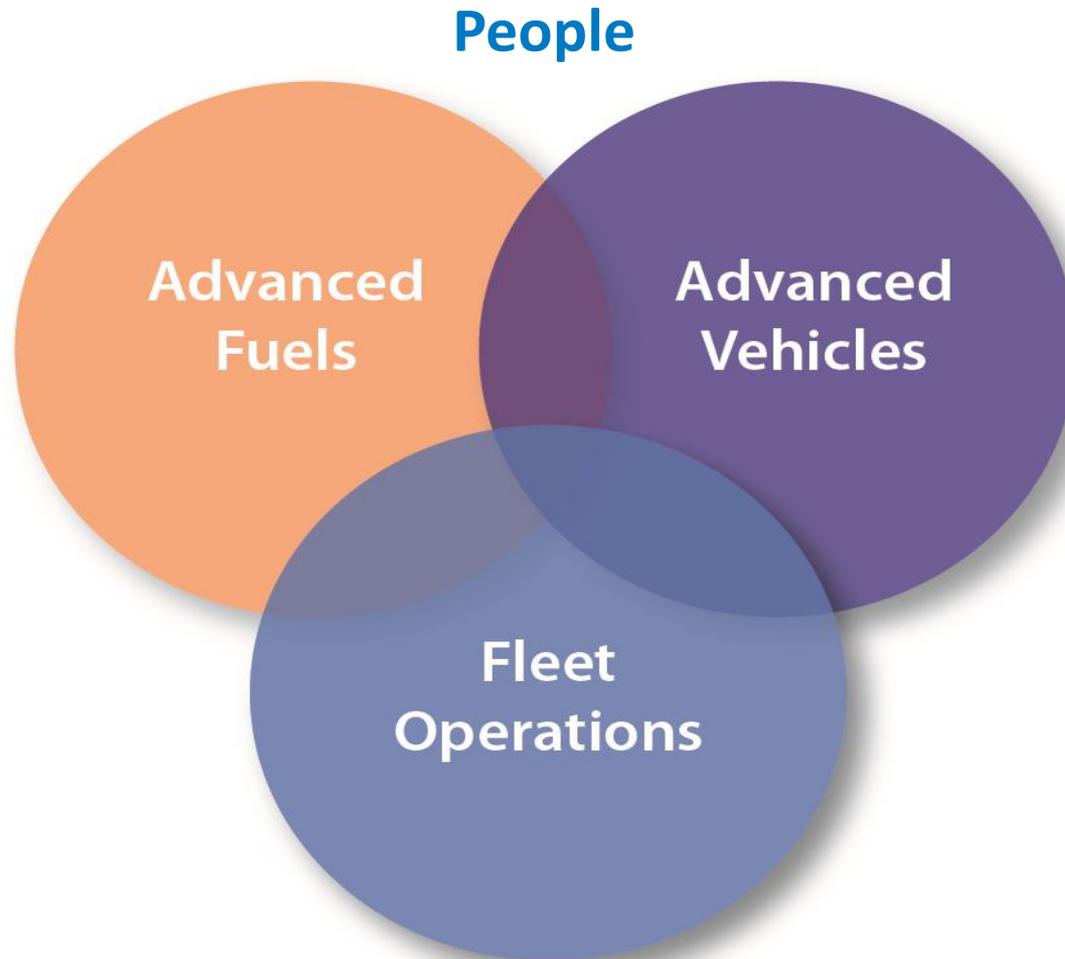
Source: GreenRoad's Fleet Leader 2013 Outlook

Courtesy of Automotive Fleet; December 11, 2012 (www.automotive-fleet.com)

One Size Does NOT Fit All

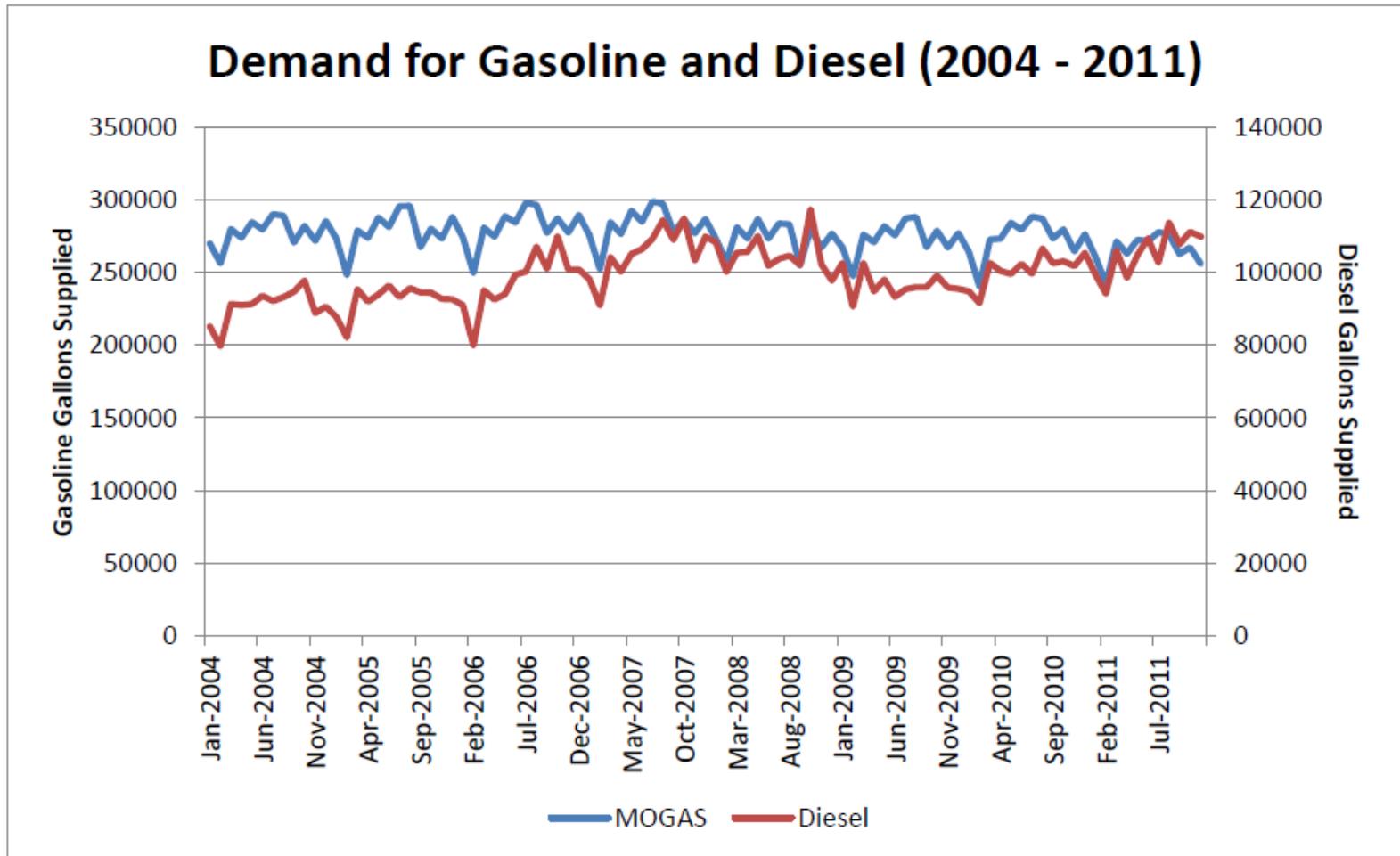


NREL's Role in Making Calculated Decisions



Compliance & Regulations

Intersection of Gasoline and Diesel Demand

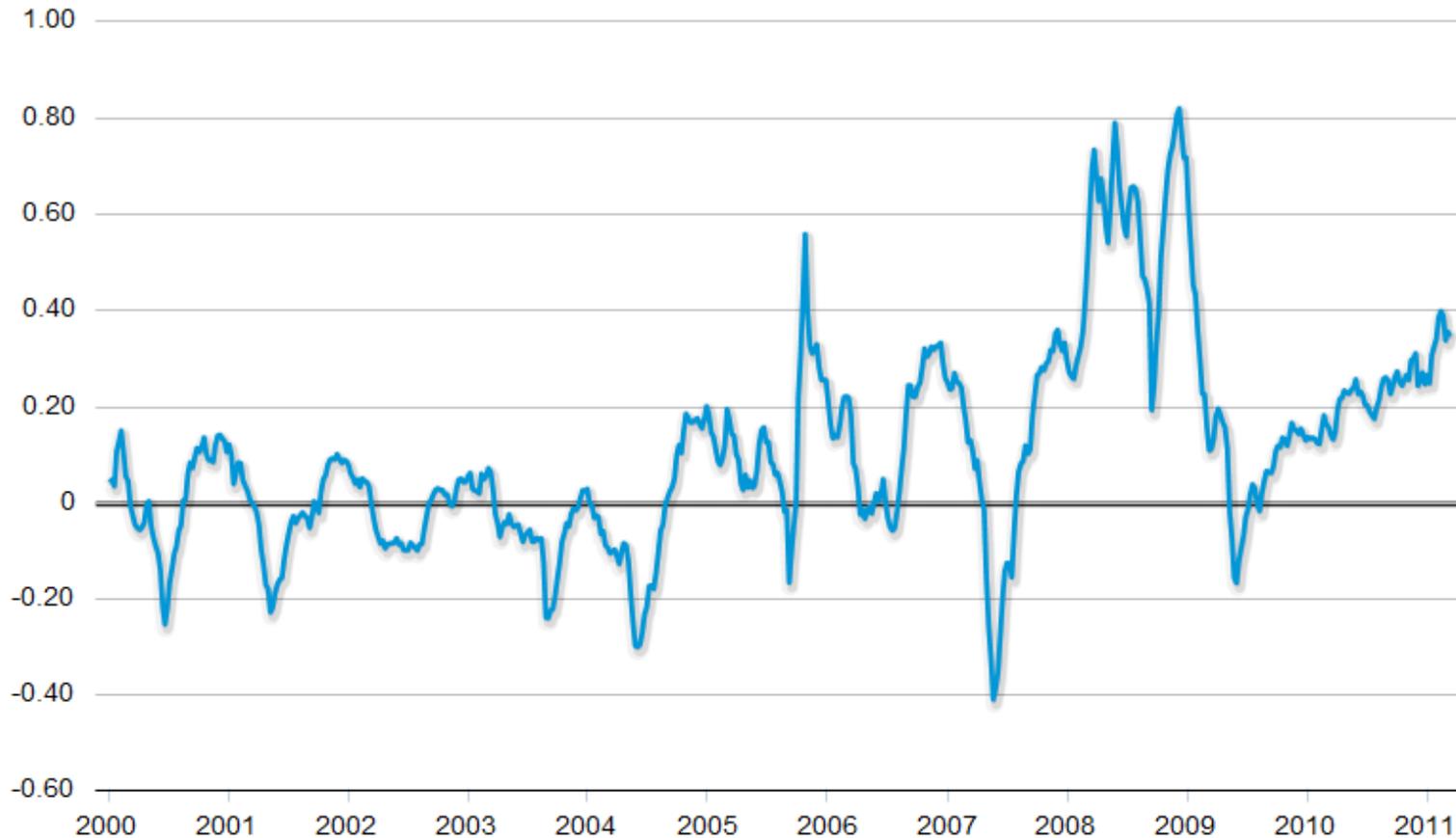


Source: NACS Retail Fuels Report 2012

Diesel Retail Prices Outpace Gasoline

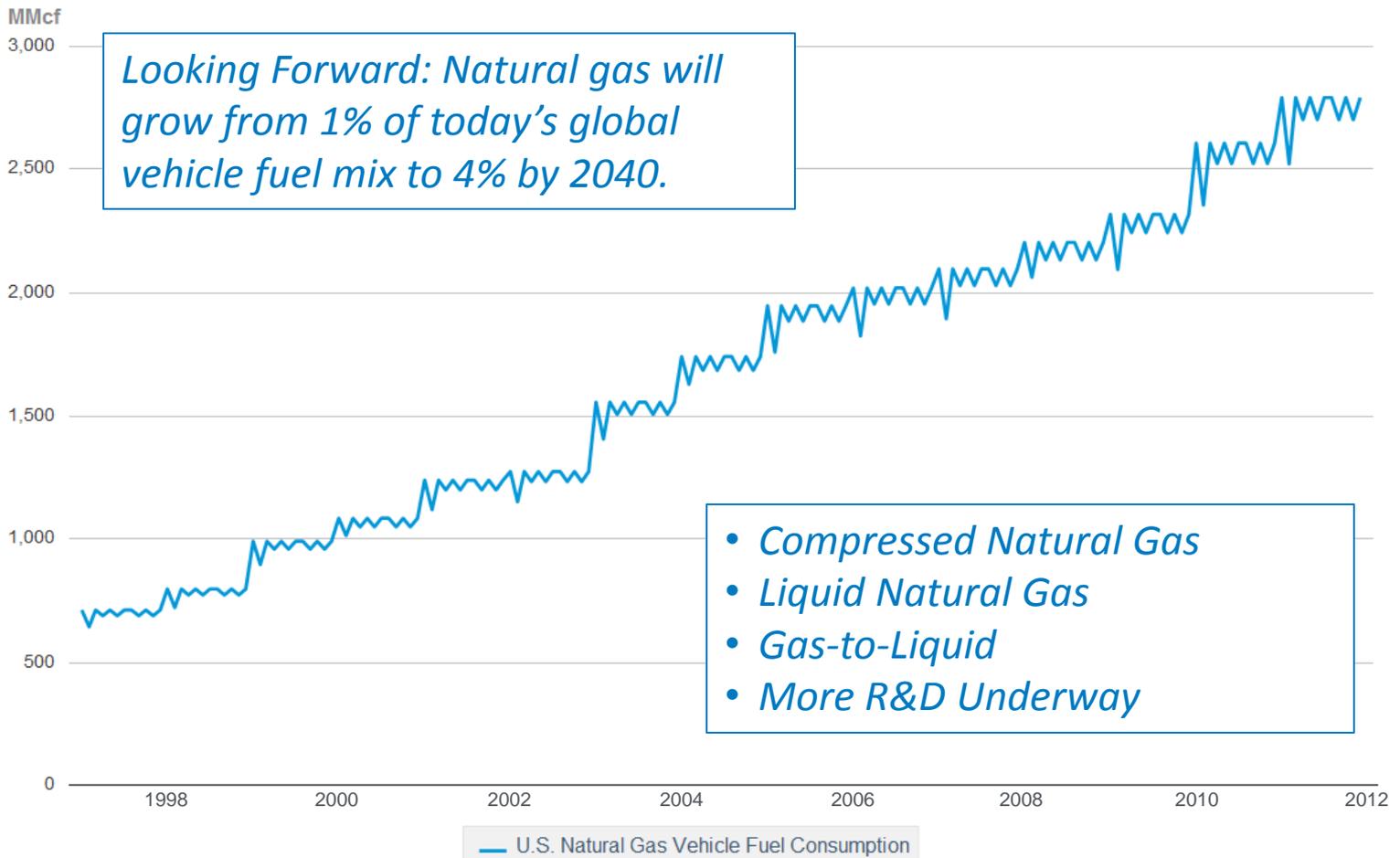
Retail diesel price minus retail gasoline price

\$ per gallon



Source: U.S. Energy Information Administration, Weekly Retail Gasoline and Diesel Prices

The Rise of Natural Gas Use in Transportation

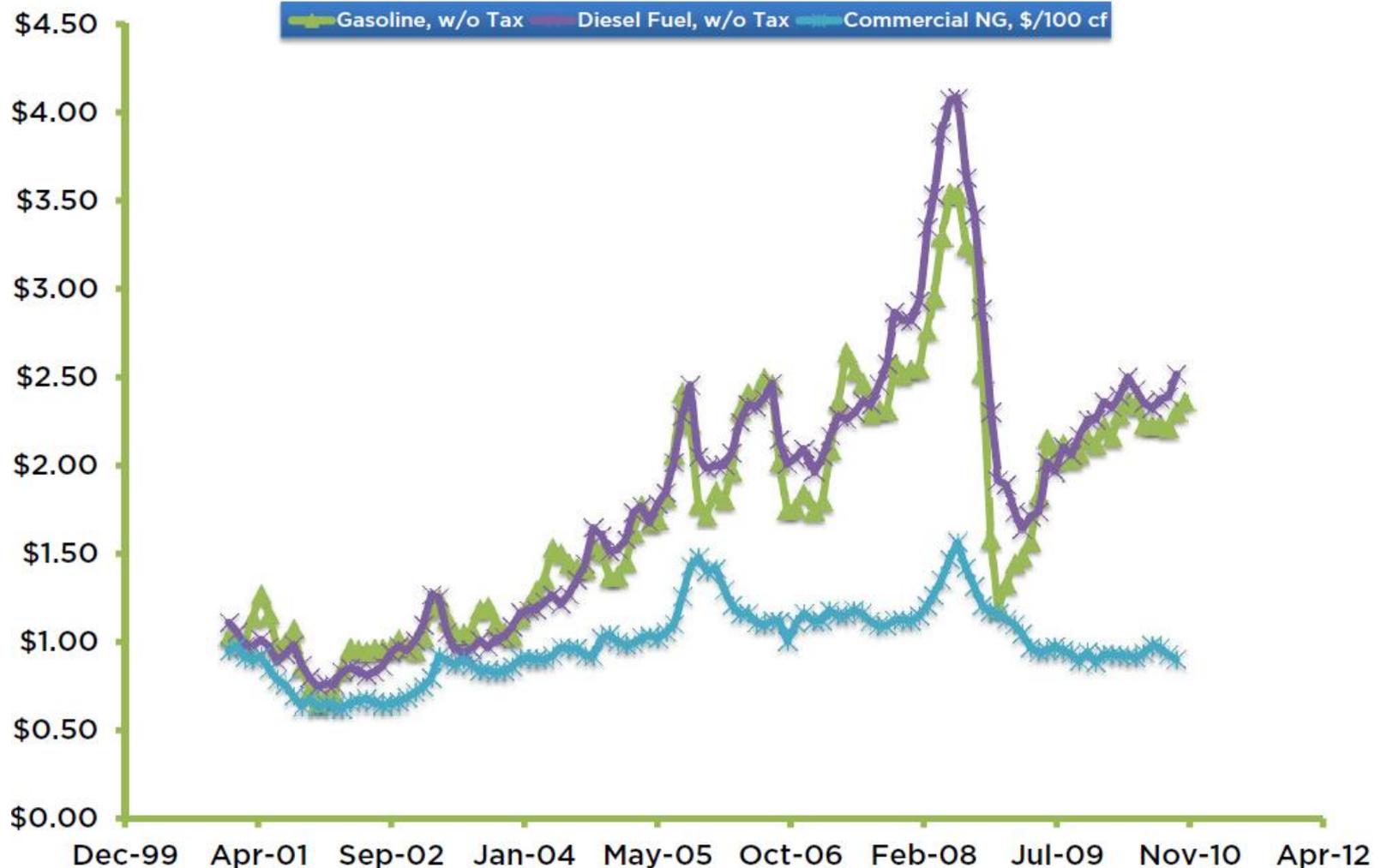


 Source: U.S. Energy Information Administration

Natural Gas Price Volatility vs. Petroleum

NATIONWIDE FUEL PRICES

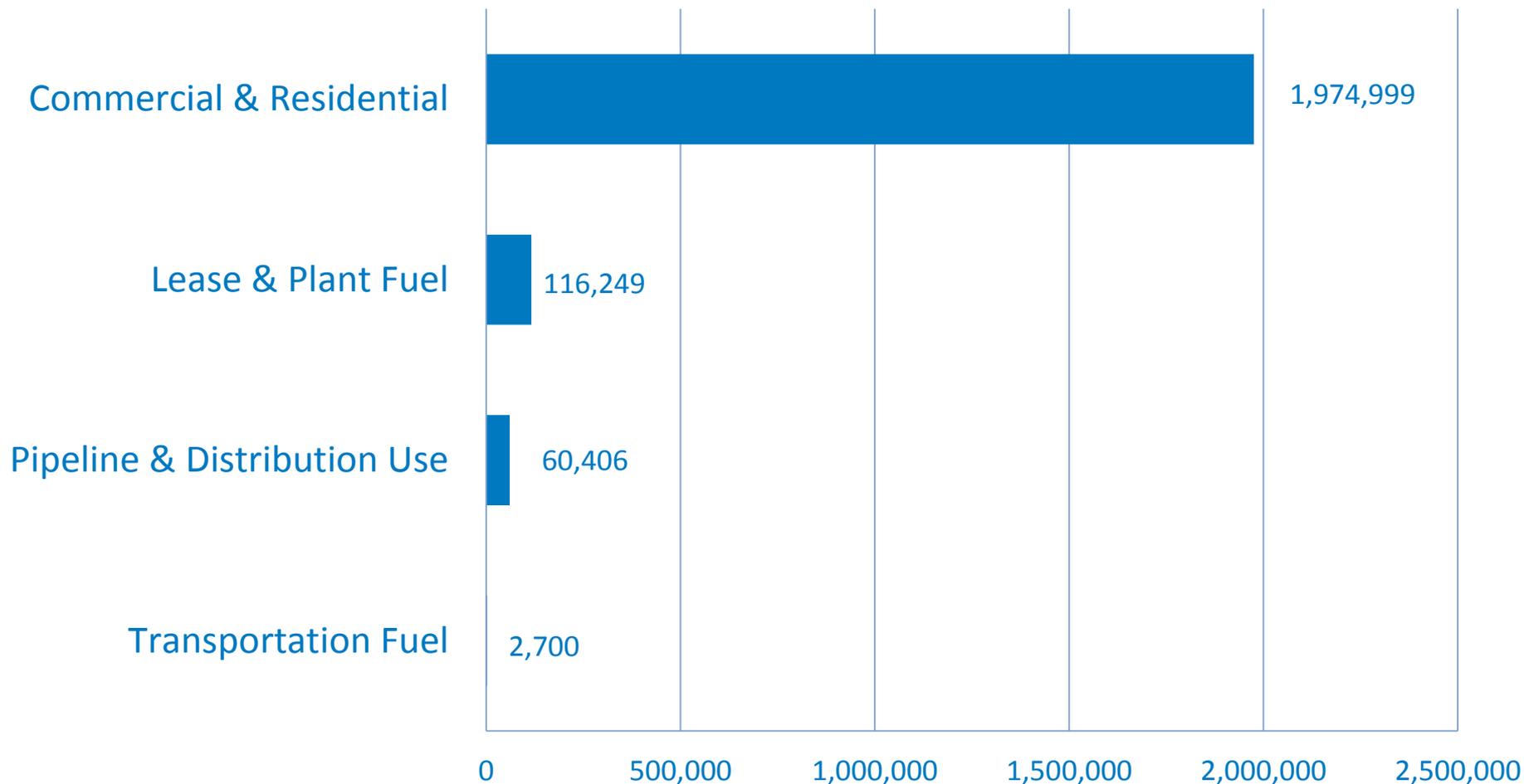
13-Jan-11



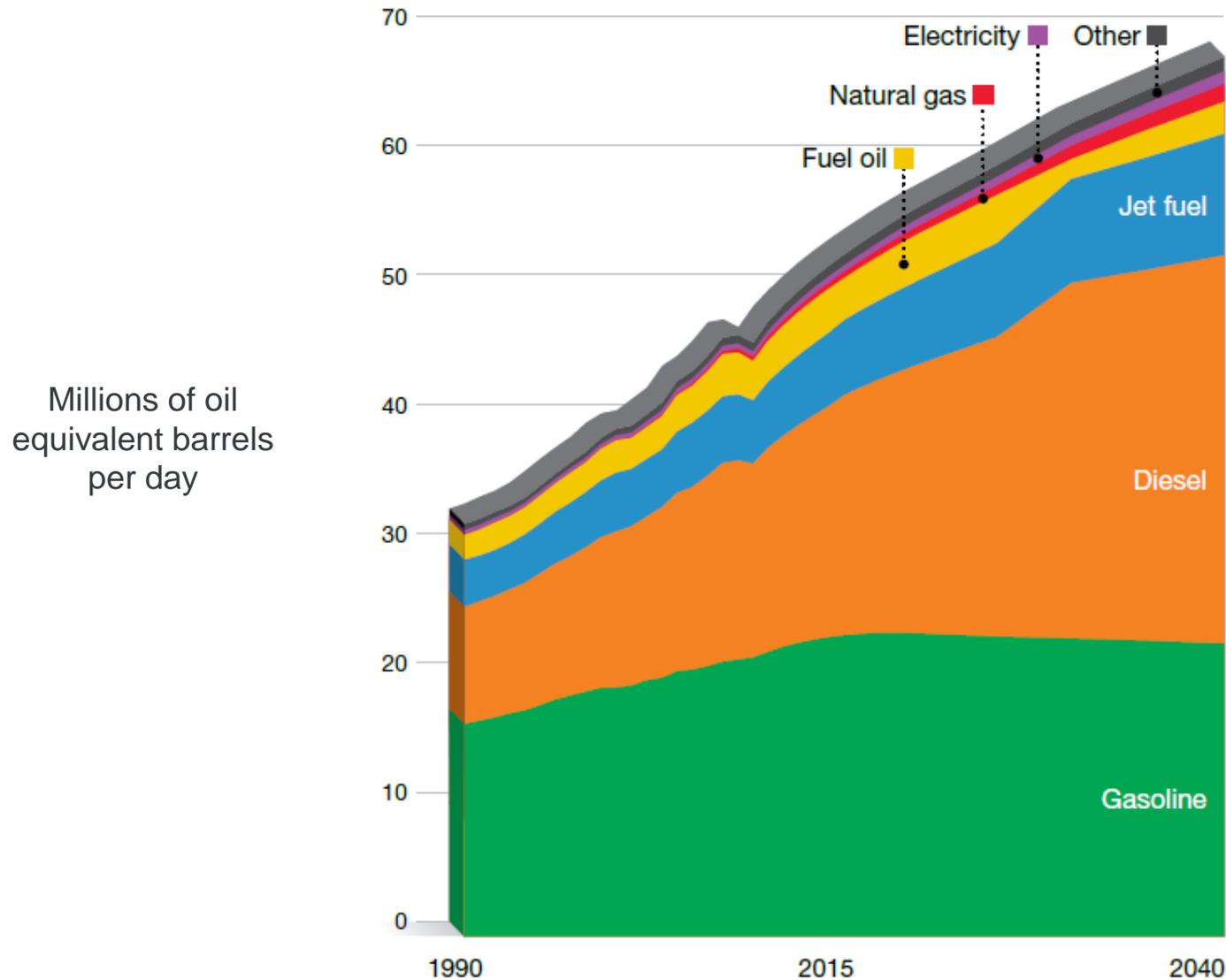
Source: U.S. Department of Energy

U.S. Natural Gas End Consumption

Mcf: November 2012



World Transportation Fuel Demand by Type



Source: Exxon Outlook for Energy 2012: A View to 2040

Spectrum of Advanced Biofuel Technologies

Near
Term

Ethanol: Grain or cellulosic material

Biodiesel: Transesterified vegetable and seed oils

Green Diesel: Hydrogenated fats, waste oils, or virgin oils

Other Fermentation Products: Butanol, acetates, lactates, etc.

Pyrolysis Liquids: Alternative feedstock to refinery

Synthesis Gas: Fischer-Tropsch liquids, methanol, dimethyl ether, or mixed alcohols.

Algae-Derived Fuels: Source of triglycerides and carbohydrates

Long
Term

Hydrocarbon Fuels: From hydrogenation or produced in-situ.

Looking Beyond Liquid Fuels

Vehicle technologies are advancing beyond liquid fuels, like these electric hybrids.

Electric vehicles, however, come with their own challenges.



Let's Talk Operations

NREL Approach to Support Fleet Operations

1

Analyze Your Fleet: Obtain data to deeply understand your fleet. How are you using your fleet now; What do you really need your fleet to do?

2

Analyze Your Options: Simulate potential fuel and vehicle technology applications against captured duty cycles.

3

Select Your Solution Portfolio: Understand what is right for entire fleet, depot, or route.

Background:

Lots of Work by the DOE and National Labs to Collect, Analyze and Report on Newly Deployed Advanced Technology

ENERGY Efficiency & Renewable Energy VEHICLE TECHNOLOGIES PROGRAM

Project Startup: Evaluating Coca-Cola's Class 8 Hybrid-Electric Delivery Trucks

Although the largest trucks—Class 8, with a gross vehicle weight rating (GVWR) above 13,000 lb—make up only 1% of the U.S. highway vehicle fleet, they are responsible for almost 20% of highway petroleum consumption. Improving the efficiency of Class 8 trucks through advanced and alternative fuels and hybridization is a high-impact way to

Advanced Technology Vehicles in Service
Advanced Vehicle Testing Activity

King County Metro Transit

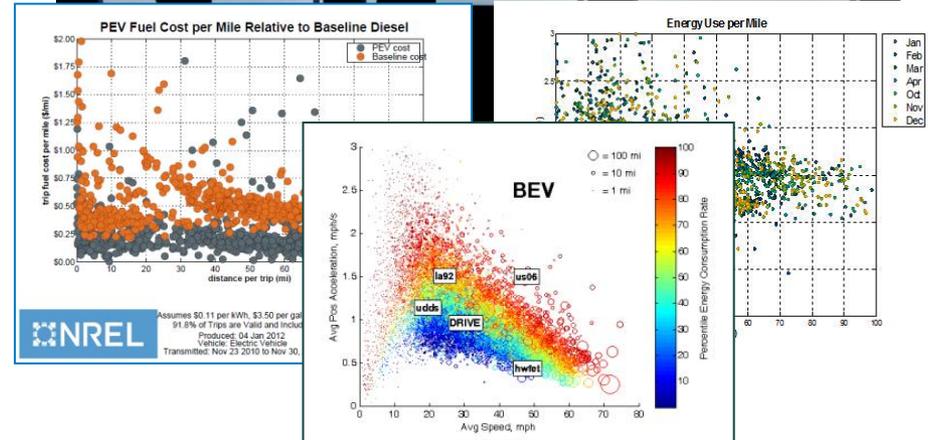
DIESEL HYBRID ELECTRIC BUSES

TESTING ADVANCED VEHICLES

Hybrid-Electric Transit Buses

NYCT Diesel Hybrid-Electric Buses
Final Results

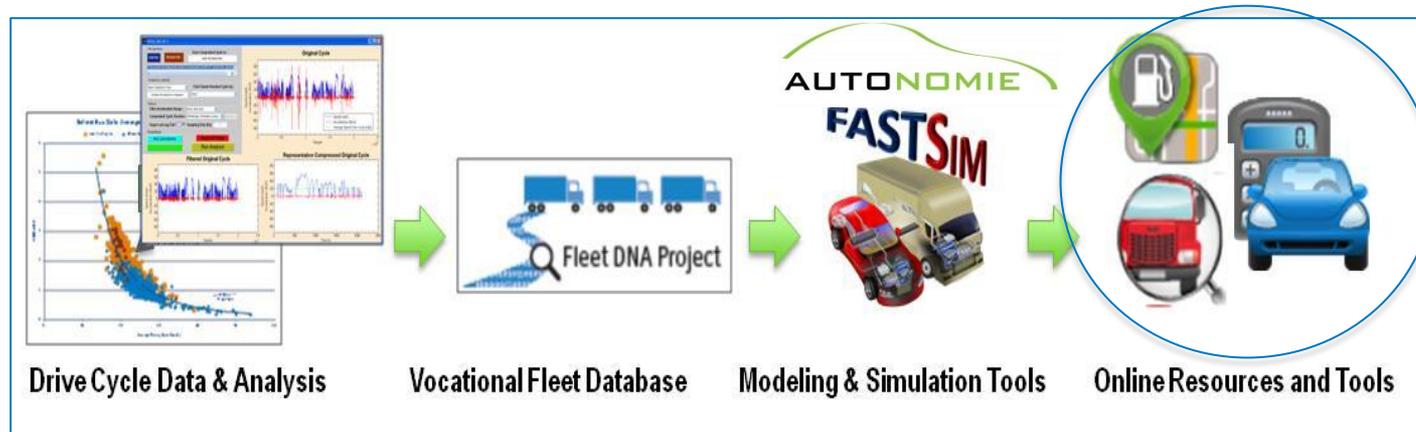
ENERGY Efficiency & Renewable Energy



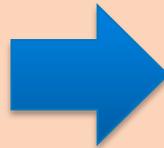
Buy it, then try it: Evaluations of newly deployed technology are very useful, but is a backward looking approach

Try it before you buy it. Simulate: Evaluations could also be forward looking ...but good data is needed for accurate assessment.

Refined Data to Make Informed Decisions



- **Drive Cycle / Duty Cycle Data**
 - speed
 - acceleration
 - grade
 - miles, hours driven
 - power take off / aux loads
- **Operating Condition Data**
 - temp, humidity, etc.
 - payload



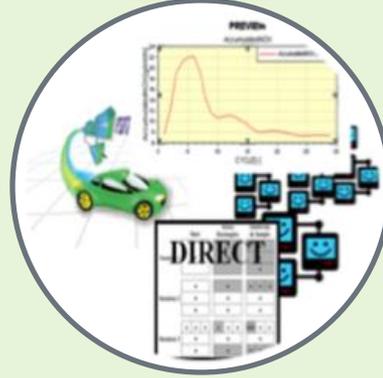
- **Vocational Analysis**
 - route / fleet averages
- **Situational Modeling & Simulation**
 - sensitivity studies
 - placement optimization
 - expected performance
- **On-Line Tools**
 - Clean Cities
 - Alternative Fuels Data Center

An Approach to Assess New Technology



Collect In-Use Data:

- Acquire Field Data
- Process Data:
 - **DRIVE™**
 - FAT (Fleet Analysis Tool)
- Compile & Summarize:
 - **(Fleet DNA**



Analyze and Simulate:

- Utilize User Specific Field Data
- Vehicle Simulation:
 - **FASTSim**
 - **Autonomie**
- Benefit Analysis:
 - **best technology for specific application**



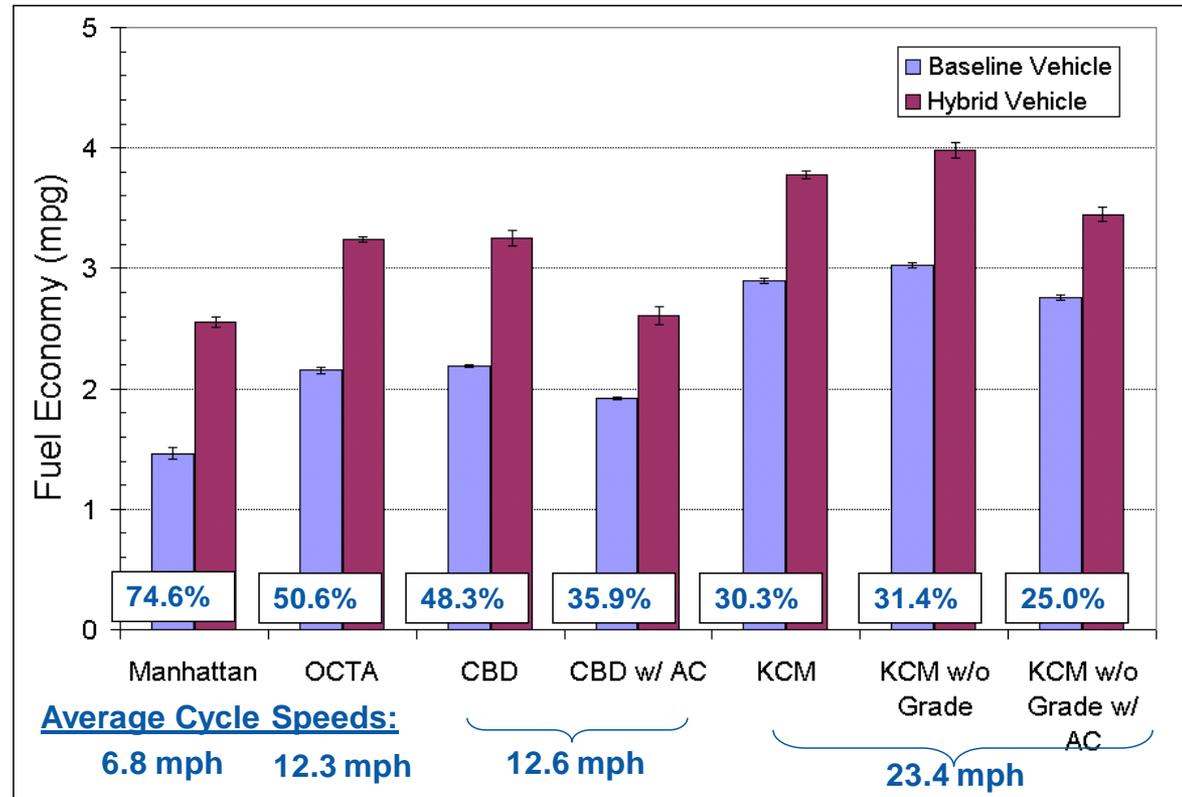
Validate in Laboratory:

- Validate field data in a controlled setting
- Quantify emissions and fuel consumption
- Explore limits, assess changes to system

Effects of Variable Duty Cycle:

1. Fuel economy variation
2. Component life variation
3. Life cycle costs/payback
4. Placement of vehicles for maximum ROI

Understand duty cycle =
Understand right
technology for application



Example: HEV Bus Fuel Economy Improvements

Drive cycle important to assess technologies such as: aero devices, low rolling resistance tires, engine sizing, transmission options, light-weighting, battery usage, driver feedback, etc.

Understanding Vocational Behavior: Fleet DNA



A vocational data base of vehicle use information: Phase 1 and Phase 2

- Phase 1: Pre-Sorted data sets
- Phase 2: Sortable Data Sets

NREL: Fleet Test and Evaluation - Fleet DNA: Vehicle Drive Cycle Analysis

http://www.nrel.gov/vehiclesandfuels/fleettest/fleet_dna.html

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Advanced Vehicles & Fuels Research
Fleet Test & Evaluation

Fleet DNA: Vehicle Drive Cycle Analysis

Fleet DNA helps vehicle manufacturers and fleet managers understand the broad operational range for many of today's commercial vehicles. This tool offers access to vehicle fleet data summaries and visualizations similar to real-world "genetics" for medium- and heavy-duty commercial fleet vehicles operating within a variety of vocations.

Click on the vehicle type to access composite data, summaries, and visualizations. You can also download the [full summary and visualizations](#).

Delivery Vans	Urban Delivery Vans	School Buses	Transit Buses
Bucket Trucks	Telecommunications Vehicles	Refuse Trucks	Class 8 Trucks

Urban Delivery Vans

Fleet DNA has data for 350 urban delivery vans operating in 3 regions in the United States.

- [Composite Data](#)
- [Data Summary and Visualizations](#)

Related Studies

Learn more about the drive cycle metrics of urban delivery vans through these studies.

- [First Study Name](#)
- [Second Study Name](#)
- [Third Study Name](#)

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

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REPORTING | ADD DATA

CLASS | VOCATION | FUEL TYPE | REGION | DIVISION

VOCATION	PROVIDERS	VEHICLES	DAYS	LEGEND
Urban Delivery	5	22	397	
Telecom	2	50	68	
School Bus	4	55	75	
Urban Delivery	1	35	425	
Urban Delivery	1	35	425	

PERCENT OF TOTAL

TRIP FREQUENCY

HOURLY OF DAY | HOURLY OF WEEK

GRAPH TYPE: SCATTER | BAR | 2D | 3D

AXIS TYPE: zero_seconds | total_average_speed | total_average_speed

VOCATION	VEHICLE	TRIPS	DAYS	AVG SPEED
Urban Delivery	1	18	7	15
Urban Delivery	2	15	6	12
Urban Delivery	3	6	2	24
Urban Delivery	4	19	14	26
Urban Delivery	5	22	17	17
Telecom	6	10	4	33
Telecom	7	15	9	55
Telecom	8	36	18	47
Telecom	9	35	20	46

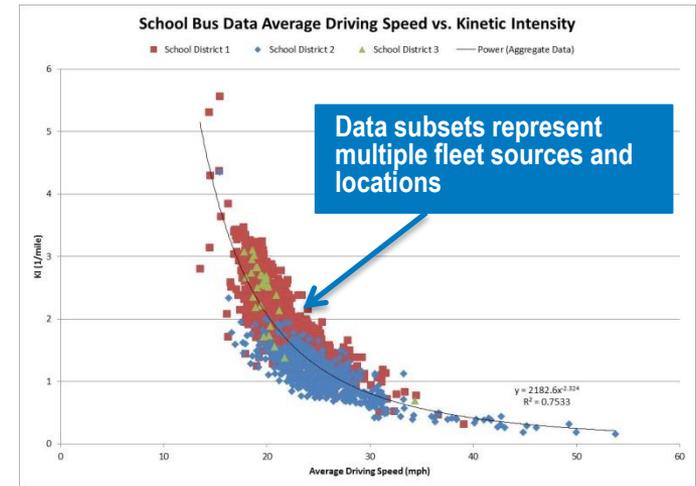
User can custom sort and graph:

- Class
- Vocation
- Fuel Type (or drivetrain)
- Region (4)
- Sub-region (based on census map)

Understanding the Big Picture: Fleet DNA



- DOE funded, NREL in partnership with ORNL
- 20+ high value metrics / data products available for each vocation
- Provides reference data for industry drive-cycle development
- OEMs: better understanding of customer use profiles
- Fleets: information on how to achieve the maximum ROI from technology investment
- Funding Agencies: optimize impact of financial incentive offers
- R&D Activities: data source for modeling and simulation.

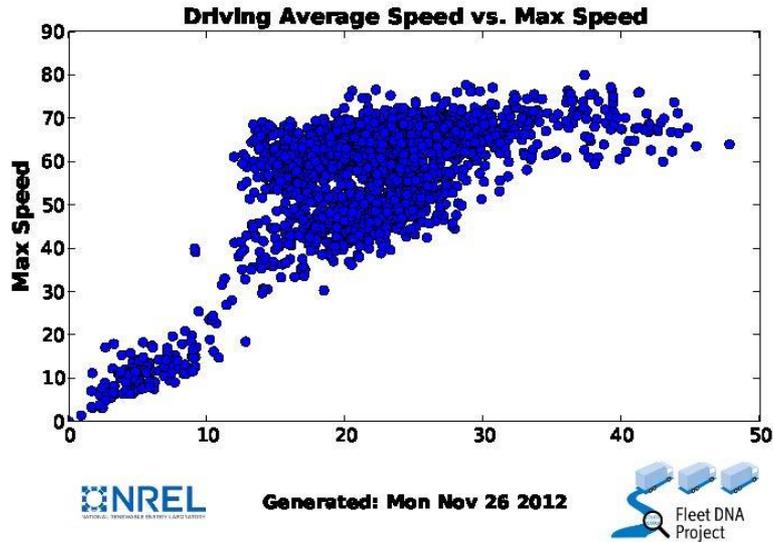


Data: Aggregated and Anonymous
Fleets Not Identified!

Preliminary Participation:

- NTEA / GTA
- DOE
- SCAQMD
- CARB
- ORNL
- Calstart
- Zonar
- Many, Many Fleets and OEMS

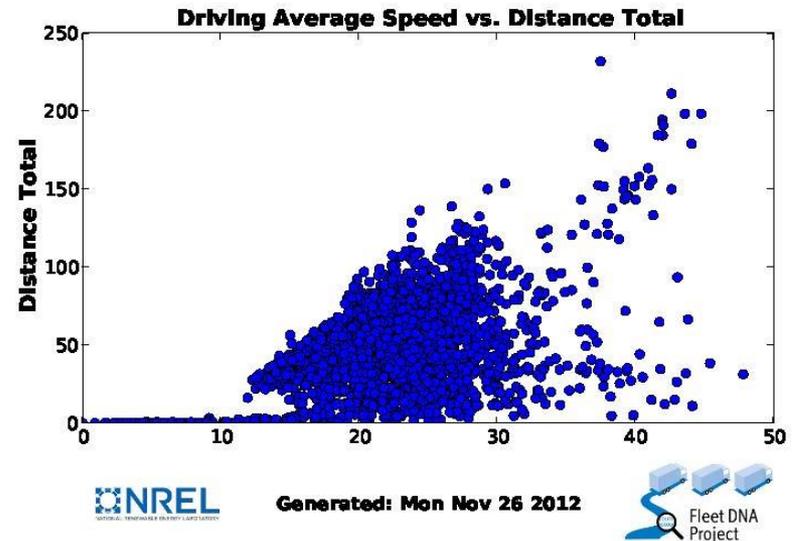
Example Data Output of Fleet DNA: Phase I



Data Products to visualize and calculate vehicle use patterns

Visualizations show data variability

Data analysis enables calculated decision making



Data Sets

Available

- Class 4-6 Delivery Vans (parcel, food, uniform)
- Class 3-4 Light Aerials (telecom service)
- Class 5-6 Aerial (utilities)
- Class 3 Service Vans (telecom)
- Class 8 Tractor / Trailer (beverage delivery)
- Class 6 Box Trucks (in-city delivery)
- EV MD Delivery Vans (multiple uses)

Acquired, Coming Soon

- Class 8 OTR Tractor Trailers
- Transit Buses
- Shuttle Buses (airport, specialty)
- Refuse Trucks (multiple types)
- Tow Trucks

Pursuing

- Class 8 OTR Tractor Trailers
- Transit Buses
- Shuttle Buses
- Refuse Trucks
- Tow Trucks
- High PTO Use Work Trucks

DOE Data Priorities:

- 1) National Fuel Consumption
- 2) Payback / ROI Success
- 3) Scalable or Transferable technology

Required Data

Parameter	Frequency	Source	Required	Desired
Time	1 hz	CAN / J1939	x	
Date	1 hz	CAN / J1940	x	
Vehicle ID	1 / day	CAN / J1941	x	
Vehicle Speed (MPH)	1 hz	CAN / J1942		x
Engine Speed (RPM)	1 hz	CAN / J1943		x
Engine Mode (on/off)	1 hz	CAN / J1944		x
Instantaneous Fuel Usage (gram)	1 hz	CAN / J1945		x
Cumulative Fuel Usage (litre)	1 hz	CAN / J1946		x
PTO Engage (y or n) if applicable	1 hz	CAN / J1947		x
PTO % (if applicable)	1 hz	CAN / J1948		x
Elevation	1 hz	CAN / J1949	x	
GPS Latitude	1 hz	GPS	x	
GPS Longitude	1 hz	GPS	x	
GPS HDOP	1 hz	GPS	x	

Typical data required from fleets for inclusion into Fleet DNA

- may vary by application / situation
- other data can be useful if available and needed: torque demands, ambient temp, gear, etc....

Hardware Requirements / Utilized

NREL hardware:

- gathers basic drive cycle data + additional if desired
- TSI 747 Pro - GPS only units

Other Options:

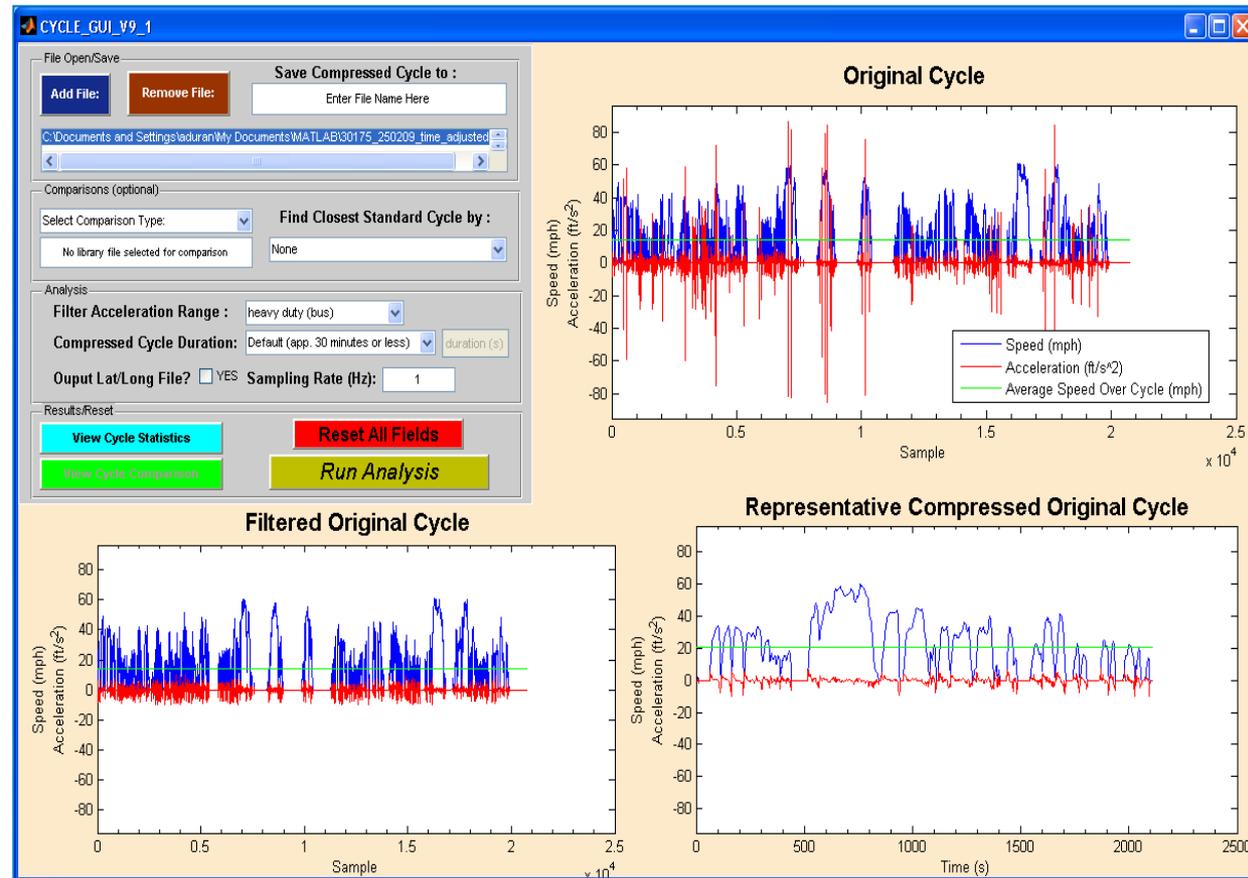
- Use Existing Telematics – leverage large scale, long term tracking efforts
- Fleet Analysis + Telematics providers for in depth and specialized short term data capture



Data Analysis: Drive Cycle Data

Drive-cycle Rapid Investigation, Visualization and Evaluation Tool (DRIVE)

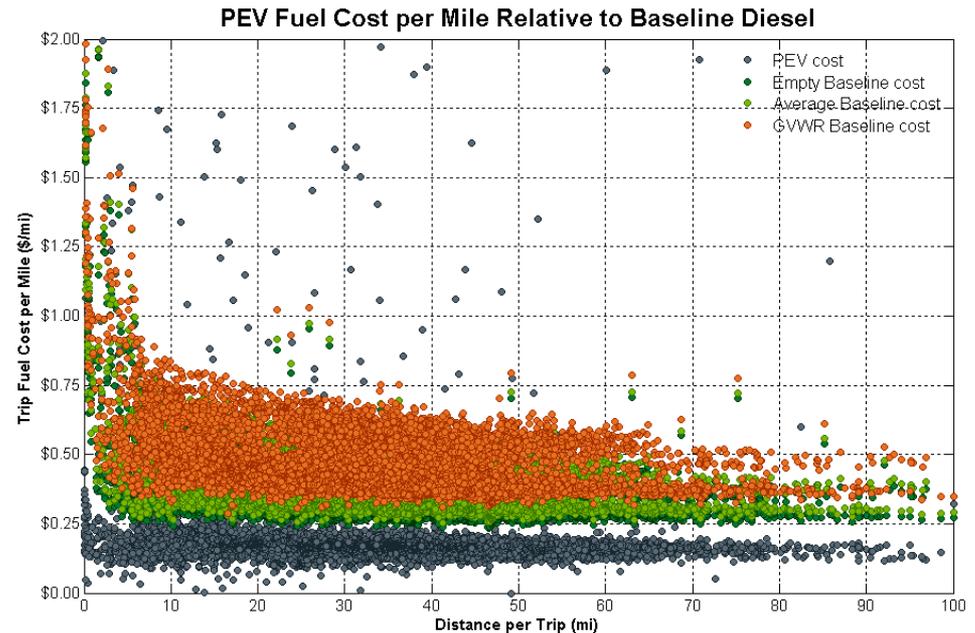
- Created to help fleets and OEMs understand vehicle usage for proper vehicle placement, design and testing
- Combines large amounts (days or weeks of usage) of user data, filters, creates new cycles
- Integrated with Fleet DNA for public use
- Quickly processes and analyzes data :
 - over 150 metrics
 - histograms
 - scatter plots
 - Creates custom cycle
 - Recommends standard cycles



Data Analysis: Simulation

Future Automotive Systems Technology Simulator (FASTSim)

- Vehicle modeling tool to similar to Autonomie
- FastSim is well suited for conducting large data sweeps
 - short run time in accessible Excel environment
 - Validated performance output: fuel economy and cost results



Example Use: Fleet DNA & the GTA



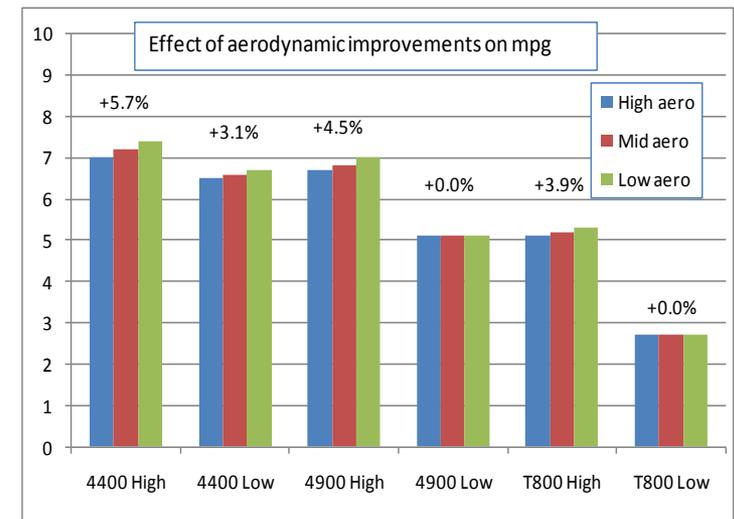
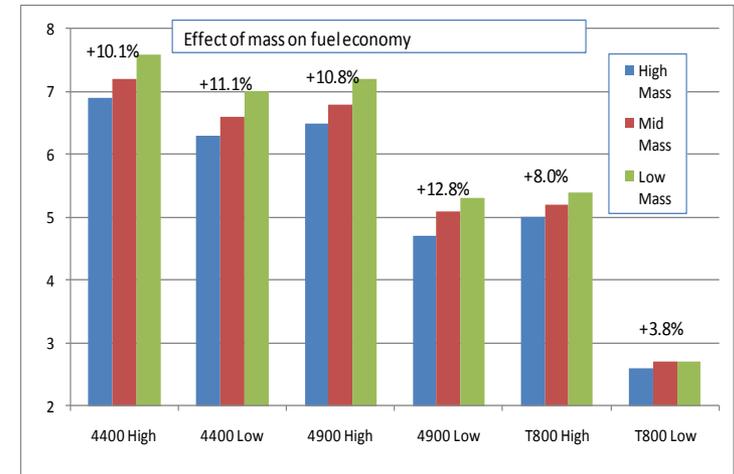
GTA: membership with interest in improving vehicle efficiency



Fleet DNA: DOE supported database and analysis of technology

- GTA identifies & recruits interested fleet /technology for data analysis
- Fleet DNA provides drive cycle analysis back to data provider
- Fleet DNA performs simulation of vocational data set to assess benefit of technology for the specific usage patterns:

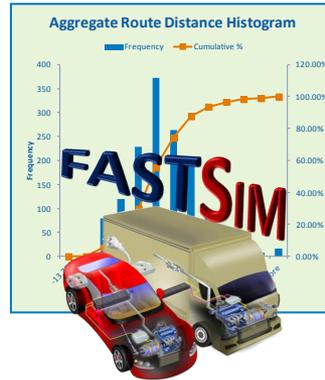
- Aero improvement
- Rolling Resistance
- Engine sizing
- Transmission options
- Mass reduction
- Driving behavior
- HEV, EV options
- Anti-Idle options
- Natural Gas and Biofuel options



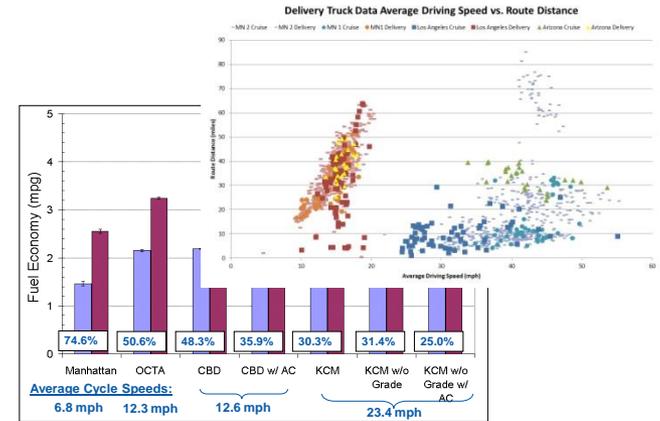
Summary: Calculated Decision Making



Capture Baseline Data



Analyze Data & Simulate Performance



Identify best application for technology

1. Provide Fleets, OEM's and Researchers with refined data and analysis of options specific to their needs
2. Create and maintain an accessible data base for public use
3. Recommend drive cycles
4. Identify most appropriate technologies for observed drive cycle data

Interested in Participating?

The screenshot shows the NREL website's 'Fleet Test & Evaluation' section. The page features a navigation menu with categories like 'ABOUT NREL', 'ENERGY ANALYSIS', 'SCIENCE & TECHNOLOGY', 'TECHNOLOGY TRANSFER', 'TECHNOLOGY DEPLOYMENT', and 'ENERGY SYSTEMS INTEGRATION'. The main content area is titled 'Fleet DNA: Vehicle Drive Cycle Analysis' and includes a detailed description of the project's goals, a list of transportation data types, and information on how to access the data and contact project partners. A sidebar on the left lists various research and development topics. The page also includes a search bar, a 'Printable Version' link, and a footer with contact information and a copyright notice.

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Vehicles & Fuels Research

Fleet Test & Evaluation

More Search Options
Site Map

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Fleet Test and Evaluation Home

Research & Development

- Vehicle Drive Cycle Analysis
- Hybrid Electric Drive Systems
- Electric and Plug-In Hybrid Electric Drive Systems
- Alternative Fuels
- Truck Efficiency

Partnerships

Publications

Working with Us

Fleet DNA: Vehicle Drive Cycle Analysis

Fleet DNA provides data useful for vehicle drive cycle analysis to help vehicle manufacturers and fleet managers understand the broad operational range for many of today's commercial vehicle vocations. The Fleet DNA Project aims to accelerate the evolution of advanced vehicle development and support the strategic deployment of market-ready technologies that reduce costs, fuel consumption, and emissions.

At the heart of the Fleet DNA Project is a clearinghouse of medium- and heavy-duty commercial fleet transportation data for optimizing the design of advanced vehicle technologies or for selecting a given technology to invest in. Designed by NREL in partnership with Oak Ridge National Laboratory, this online tool will be available in December 2012.

Transportation Data

This benchmarking tool will offer easy-to-interpret data summaries and graphical data outputs based on real-world "genetics" from medium- and heavy-duty commercial fleet vehicles operating within a variety of vocations. These summaries will be based on thousands of data points of operation per vocation, with an initial focus on transit buses, school buses, delivery vehicles, regional tractors, utility trucks, cabs, and sleeper-cab trucks.

The Fleet DNA Project will feature transportation data that a variety of partners gathered from various fleet evaluation and research projects, particularly those that focus on the vocations and vehicles that consume the most fuel in the United States.

A wide range of statistics, compiled for each vocation and/or vehicle type, will be publically available. More detailed data and specialized analysis could be accessible to partners who contribute data or provide additional support. Example data sets might contain information such as aggregated route distance, average speed, maximum acceleration, stops per mile, load and grade statistics, and many other drive cycle metrics along with comparisons to standard industry test cycles. Users will be able to produce customized datasets using the Fleet DNA tool.

More Information

For more information refer to the [Fleet DNA fact sheet](#) or contact [Kevin Walkowicz](#) at 303.275.4492 to discuss partnership opportunities.

Printable Version

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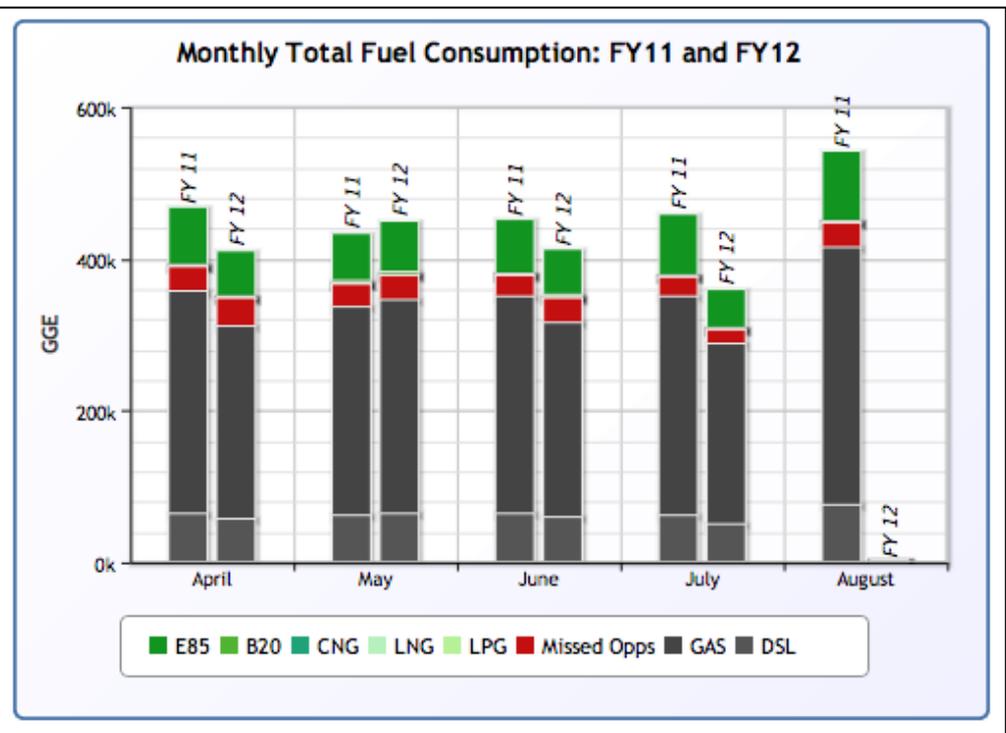
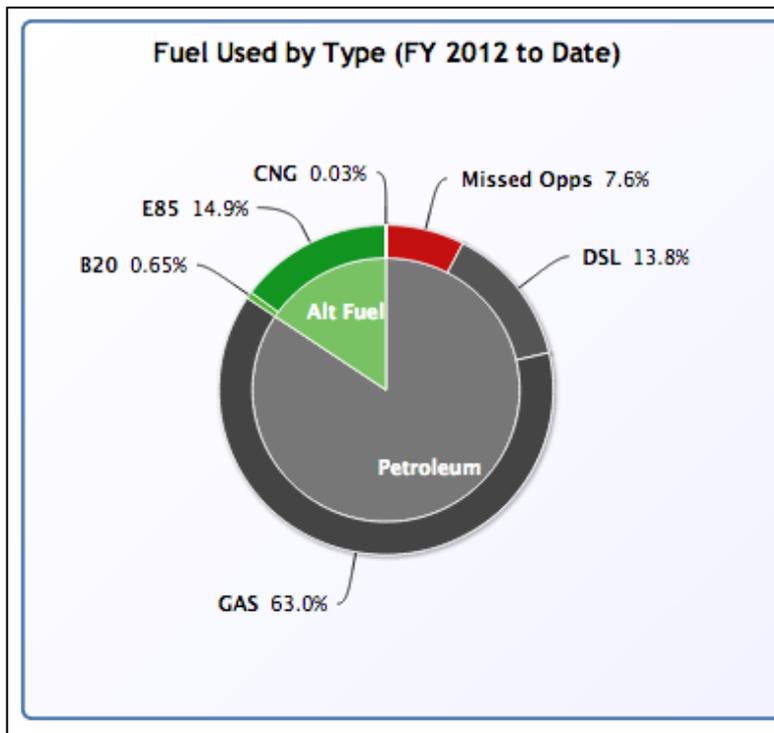
Content Last Updated: January 30, 2013

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www.nrel.gov/vehiclesandfuels/fleetttest/research_fleet_dna.html

FleetDASH Tour

- Available datasets provide *Actionable Analytics/Business Intelligence*
- Economies of scale: Standard platform for all Federal agencies
- Track fuel consumption throughout the year (30K ft. view)



<https://federalfleets.energy.gov/FleetDASH/>

FleetDASH Tour

Search

Fleet Tag

Missed Opportunity Summary: 8 Missed Opportunities totaling 105 GGEs involving 4 vehicles.

- Vehicle/Transaction level detail reveals precisely WHO and WHERE

Vehicles in the Federal Supply Service; All Other fleet

Tag	Vehicle Fuel Type	Petroleum		Alt Fuels		This Month Total Fuel Use (GGE)	Missed Opportunities	
		Total GGE	% of Total Fuel Use	Total GGE	% of Total Fuel Use		Total GGE	% of Total Fuel Use
G111377G ⓘ	E85	44	100%	0	0%	44	41	93%
G414581G ⓘ	E85	35	100%	0	0%	35	35	100%
G411680H ⓘ	E85	14	100%	0	0%	14	14	100%
G107115H ⓘ	E85	13	100%	0	0%	13	13	100%
G410651E	DSL	9	100%	0	0%	9	0	0%

Transactions corresponding to Tag# G111377G from the Federal Supply Service; All Other fleet

Station Name	Address	City	State	Zip	Fuel Type Purchased	Date	GGEs Purchased	Missed Opportunity	Alternate Station
Circle K - 01947	5501 E GOLF LINKS RD	Tucson	AZ	85711	GAS	2013-02-01	4.05	Yes	Alternate Station
Giant Store 6615	6150 S KOLB RD	Tucson	AZ	85756	GAS	2013-02-04	12.81	Yes	Alternate Station
Giant Store 6615	6150 S KOLB RD	Tucson	AZ	85756	GAS	2013-02-08	14.23	Yes	Alternate Station
Giant Store 6615	6150 S KOLB RD	Tucson	AZ	85756	GAS	2013-02-14	10.18	Yes	Alternate Station

Vehicle Details (G11-1377G)

Customer Detail:

RANDAL PATTERSON
 Federal Supply Service, All Other
 GSA, AREA PROPERTY OFFICE - 12575 NORTH
 SKODA DRIVE
 MARANA AZ 856530000
 RANDAL.PATTERSON@GSA.GOV
 (520)4000308 - Ext:

Vehicle Detail:

Tag: G11-1377G
Make/Model: CHEVROLET - IMPALA
Fuel Type: Ethanol / Unleaded Gasoline
Vehicle Type: Sedan/St Wgn Midsize
BOAC: 479142
SIN: 10B.11GA
Garage Zip: 85653
Date Assigned: 4/28/08
Emergency Response: No
Law Enforcement: No
Avg Monthly Mileage: 537.00

- Vehicle/Transaction level detail reveals precisely WHO and WHERE

Search

Fleet

Missed Opportunity

Vehicles in the

Tag

[G111377G](#) ⓘ

[G414581G](#) ⓘ

[G411680H](#) ⓘ

[G107115H](#) ⓘ

[G410651E](#) ⓘ

Transactions corre

Station Name **Address**

Circle K - 01947 5501 E GOL
LINKS RD

Giant Store
6615 6150 S KOLB
RD

Giant Store
6615 6150 S KOLB
RD

Giant Store
6615 6150 S KOLB
RD

Vehicle 1 of 15 on this page

Total Use	This Month	Missed Opportunities	
	Total Fuel Use (GGE)	Total GGE	% of Total Fuel Use
44	44	41	93%
35	35	35	100%
14	14	14	100%
13	13	13	100%
9	9	0	0%

ply Service; All Other fleet

Station	GGEs Purchased	Missed Opportunity	Alternate Station
-02-01	4.05	Yes	Alternate Station
2013-02-04	12.81	Yes	Alternate Station
2013-02-08	14.23	Yes	Alternate Station
2013-02-14	10.18	Yes	Alternate Station

FleetDASH Tour

Search

Fleet Tag

Missed Opportunity Summary: 8 Missed Opportunities totaling 105 GGEs involving 4 vehicles.

- Vehicle/Transaction level detail reveals precisely WHO and WHERE

Vehicles in the Federal Supply Service; All Other fleet

Tag	Vehicle Fuel	Petroleum		Alt Fuels		This Month Total Fuel Use	Missed Opportunities	
		Total GGE	% of Total Fuel	Total GGE	% of Total		Total GGE	% of Total Fuel Use
G111377G ⓘ								93%
G414581G ⓘ								100%
G411680H ⓘ								100%
G107115H ⓘ								100%
G410651E								0%

Find Stations | Plan a Route

Ethanol (E85) ▾

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Ethanol stations near 5501 E GOLF LINKS RD Tucson AZ 85711
Excluding private stations
 Payment: WEX
 Within 5 miles

A FastLane Chevron
 1999 E Ajo
 Tucson, AZ 85713
Phone: 520-664-9901
Fuel: Ethanol (E85)
Distance: 4.1 mi

Alternate Station

[Alternate Station](#)

[Alternate Station](#)

[Alternate Station](#)

[Alternate Station](#)

Station Name	Address	City	State	Zip	Fuel	Date	GGE	Yes/No	Alternate Station
Circle K - 01947	5501 S KOLB RD	Tucson	AZ	85711	GAS	2013-02-14	10.18	Yes	Alternate Station
Giant Store 6615	6150 S KOLB RD	Tucson	AZ	85756	GAS	2013-02-14	10.18	Yes	Alternate Station
Giant Store 6615	6150 S KOLB RD	Tucson	AZ	85756	GAS	2013-02-14	10.18	Yes	Alternate Station
Giant Store 6615	6150 S KOLB RD	Tucson	AZ	85756	GAS	2013-02-14	10.18	Yes	Alternate Station

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy | Source: Alternative Fuels Data Center

Alternative Fuels Data Center

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Ten Ways You Can Start to Cut Petroleum Use Right Now

There are hundreds of ways vehicle fleets and individual drivers can reduce petroleum use – and reap the benefits of lower emissions, cost savings, and energy security. Knowing where to start and selecting the options that work best for your needs and goals can be daunting, so the Alternative Fuels Data Center (AFDC) has compiled a list of actions you can take today, along with longer-term strategies for the future.



Behave yourself

Small changes in driver behavior can have big impacts on fuel economy. By breaking bad habits like jackrabbit starts, speeding, aggressive driving, and carrying unnecessary cargo, drivers can reduce fuel use by 10% to 20%. Check out the [Driving Behavior](#) section on the AFDC to find tips for fleets and individual drivers.

[+ Go the Distance](#)



Follow the leaders

Thousands of fleet managers, business owners, state and local officials, and other transportation decision makers across the country have blazed the trail toward petroleum-free transportation, so there's no need to reinvent the wheel. Before you undertake an initiative of your own, find out how others have successfully deployed alternative fuels, pushed the envelope on fuel economy, and achieved fleet efficiencies. The AFDC features dozens of [case studies](#), which you can search by geographic location, fuel or technology type, or fleet type.

[+ Go the Distance](#)



Explore the alternatives

When it comes to fueling your fleet, gasoline and diesel aren't the only options out there. It's possible to achieve emissions reductions and/or cost savings by using alternative fuels like [propane](#), [natural gas](#), [electricity](#), [biodiesel](#),



Connect with Clean Cities

If you're looking to leave petroleum in the rearview mirror, don't go it alone. The U.S. Department of Energy's [Clean Cities](#) program has nearly 100 local coalitions of fleets, fuel providers, businesses, utilities, and government agencies all



Don't sit idle

An idling vehicle gets 0 mpg. Yet drivers in the United States waste billions of gallons of fuel every year by running their engines while going nowhere. Reducing idling time has many benefits, including reductions in fuel use, fuel costs,

To Summarize . . .

- **The Energy and Transportation Sectors** are intersecting and overlapping
 - new frontier for Energy Systems Integration research
 - future diesel fuel prices are likely to be less predictable

- **Additional Complexity to Manage:** Diversified power train technologies
 - more challenging optimization problem
 - new tools are available to help match optimal solution to your application

Thank You!

Northeast and Midwest Joint Equipment Management
Meeting
Ron Schoon
June 24, 2013

Visit us online at www.nrel.gov