

U.S. Department of Energy's Clean Cities Program

U.S. DEPARTMENT OF
ENERGY | Energy Efficiency &
Renewable Energy



Clean Cities Model:

An approach to build a successful
CNG market in Almaty

Marcy Rood Werpy
Argonne National Laboratory

Clean Cities Transportation Workshop for Almaty
March 30, 2011



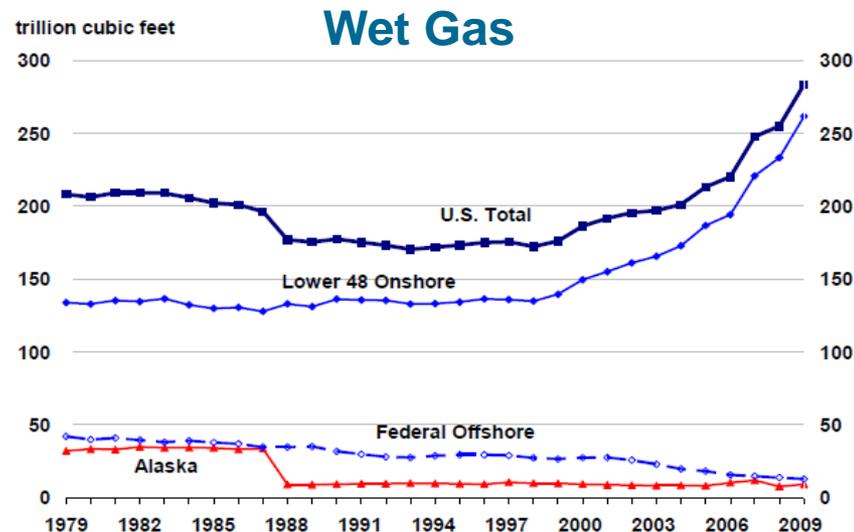
U.S. Department of Energy's (DOE) role in supporting natural gas vehicles

- Background on U.S. natural gas supplies and natural gas vehicles/engines/infrastructure
- How they are beneficial
- Deployment – Clean Cities

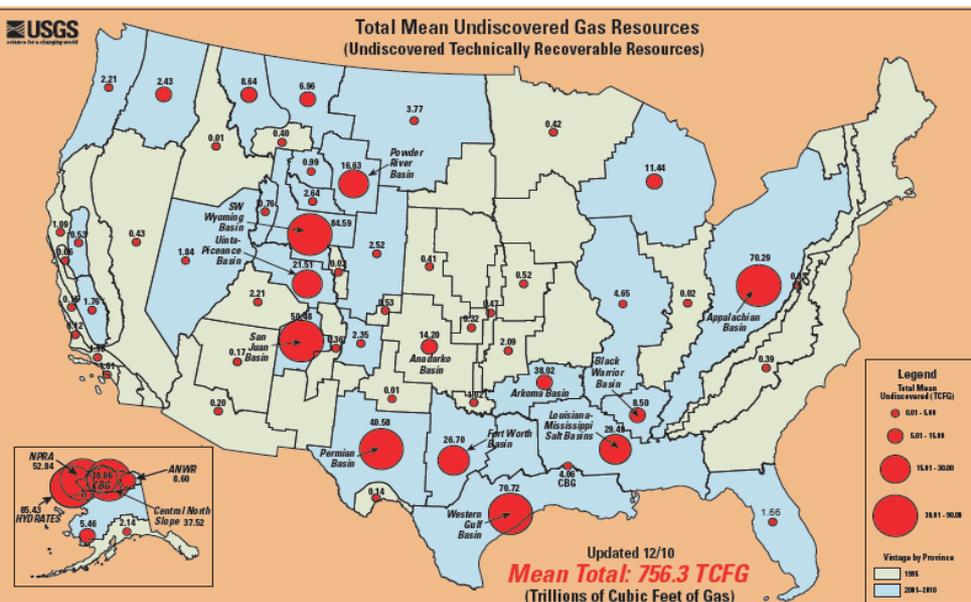


Background: U.S. Natural Gas Supplies

US natural gas (NG) reserves have grown dramatically in the past decade...

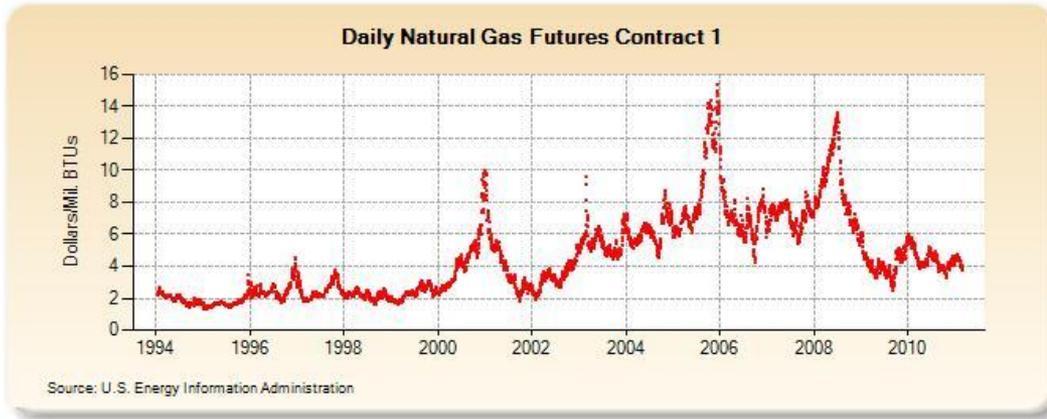


Source: U.S. Energy Information Administration

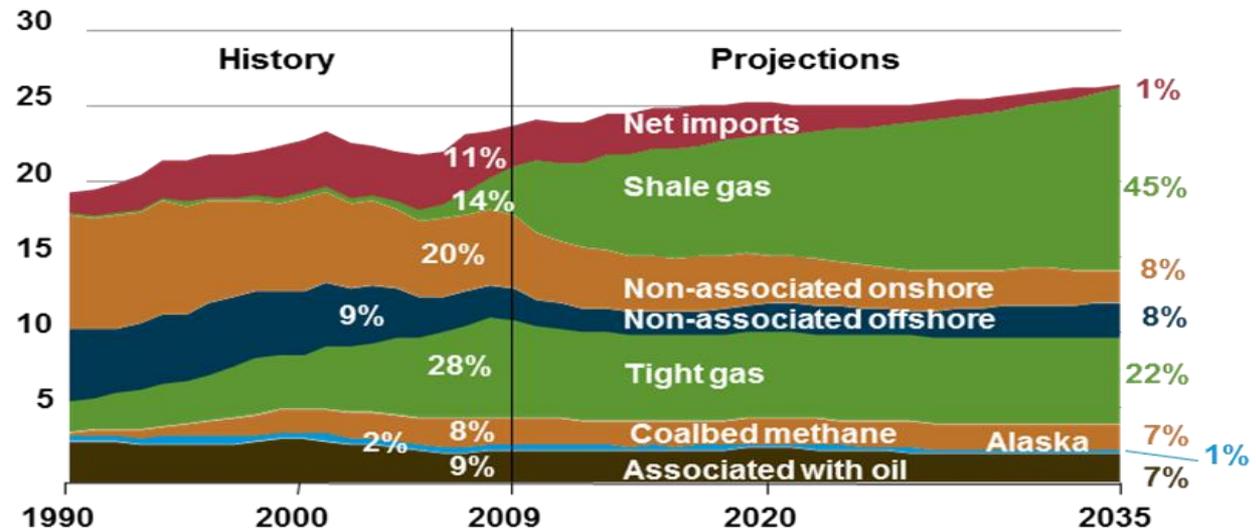


...Nearly doubling estimated technically recoverable resources

Price has dropped, demand expected to grow



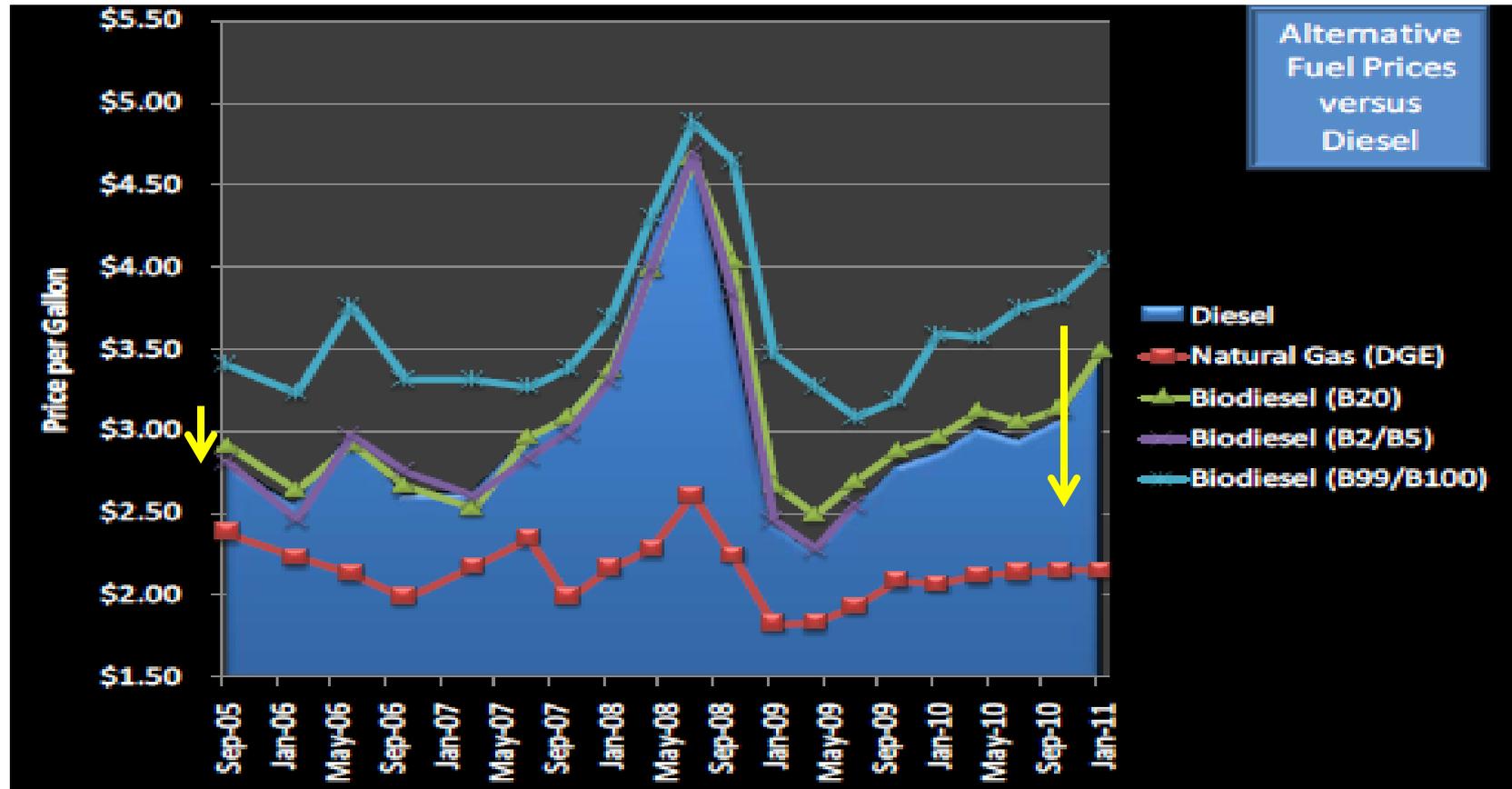
U.S. dry gas production (trillion cubic feet per year)



Shale gas/tight sands offset declines in conventional supplies

Source: U.S. Energy Information Administration

CNG has \$1.50–2.00/dge advantage over diesel



... and it's growing!

Light-Duty NGVs

- Suitable for light-duty needs in private and government fleets
- Honda Civic GX

Medium-Duty NGVs

- Vans and shuttles
- Airports and taxi fleets

Heavy-Duty NGVs

- Refuse haulers
- Transit buses
- School buses
- Long-haul trucks
- Street sweepers
- Snowplows
- Short-haul delivery trucks



Natural Gas Vehicles for America

www.ngvamerica.org

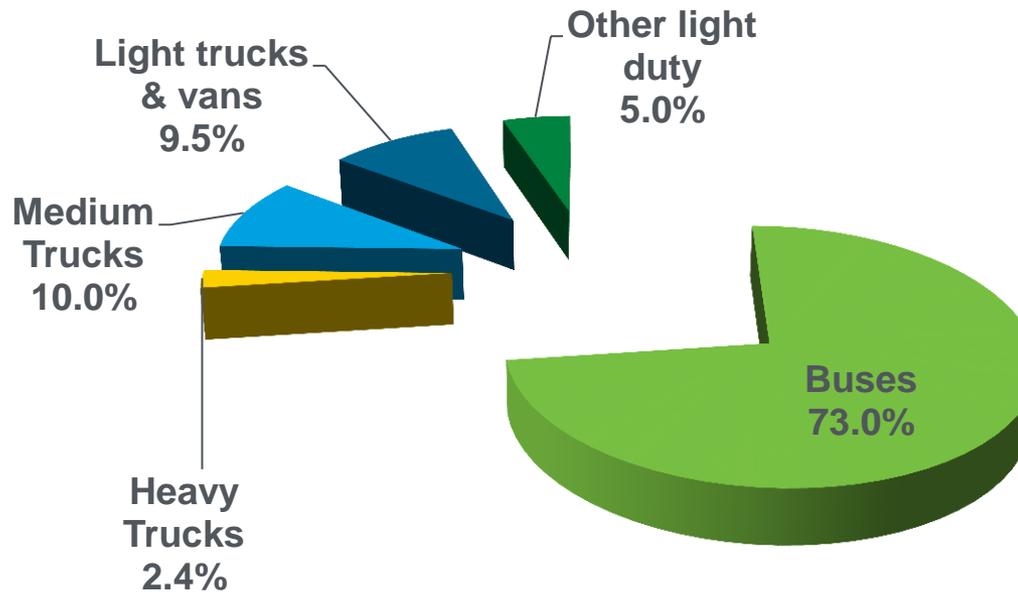
EPA/CARB 2010-certified engines are increasingly available*



Manufacturer	Displacement (model)	Engine Type (hp)	Application
Cummins-Westport	8.9 L (ISL G)	SI Stoichiometric/high EGR w/3-way catalyst (250-320)	<ul style="list-style-type: none"> • Refuse truck • Transit/school • Street sweeper • Yard hostler
Doosan Infracore America	11 L (GX 12-S)	SI Lean burn with SCR (285)	<ul style="list-style-type: none"> • Refuse truck • Transit bus
Emission Solutions	7.6 L (Phoenix NG)	SI Stoichiometric (176-275)	<ul style="list-style-type: none"> • School/shuttle • Work truck
Westport Innovations	15 L (GX) (95% LNG/5%LSD)	HPDI Pilot Ignition (400-450)	<ul style="list-style-type: none"> • Work truck • Line-haul truck

* Certified conversions are also available through Baytech, and BAF Technologies. Navistar and Clean Air Power plan to modify MaxxForce 13 engines for line-haul dual-fuel applications.

Shares of Natural Gas Fuel Use by Vehicle Type, 2007



Medium & Light Trucks Represent Most of the Remainder

Natural Gas Stations in the United States

More than 900 Public and Private Stations



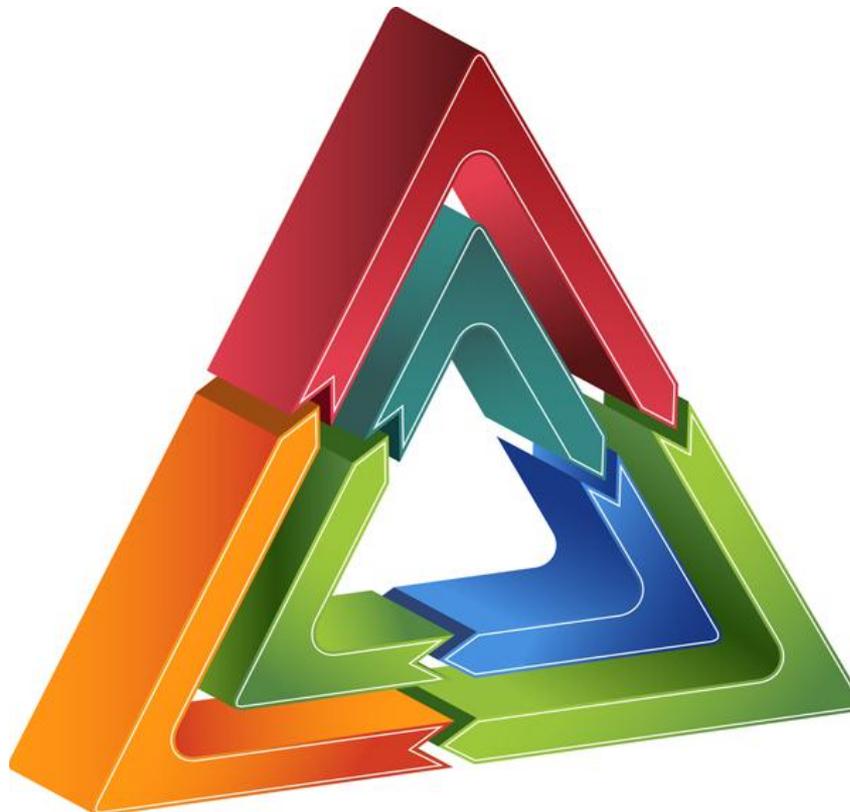
And more planned...122 CNG and 9 LNG

An Example of a U.S. Natural Gas Station



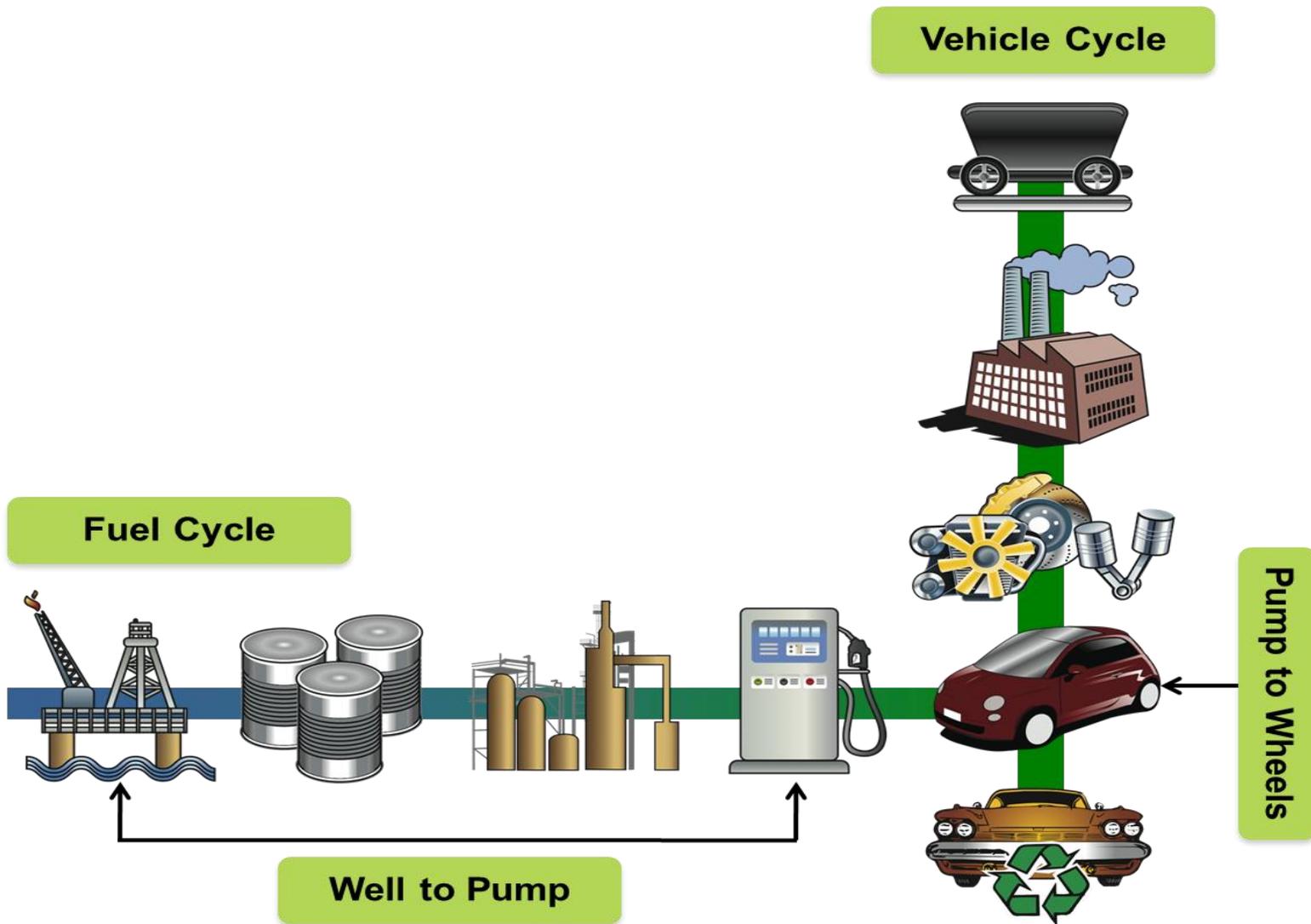
**Income Tax Credit
for Infrastructure**

**Income Tax
Credit for AFVs**



**Excise Tax Credit
of 50-cent per gge
of fuel sold**

- Mandates for Federal, State, and Fuel Provider Fleets



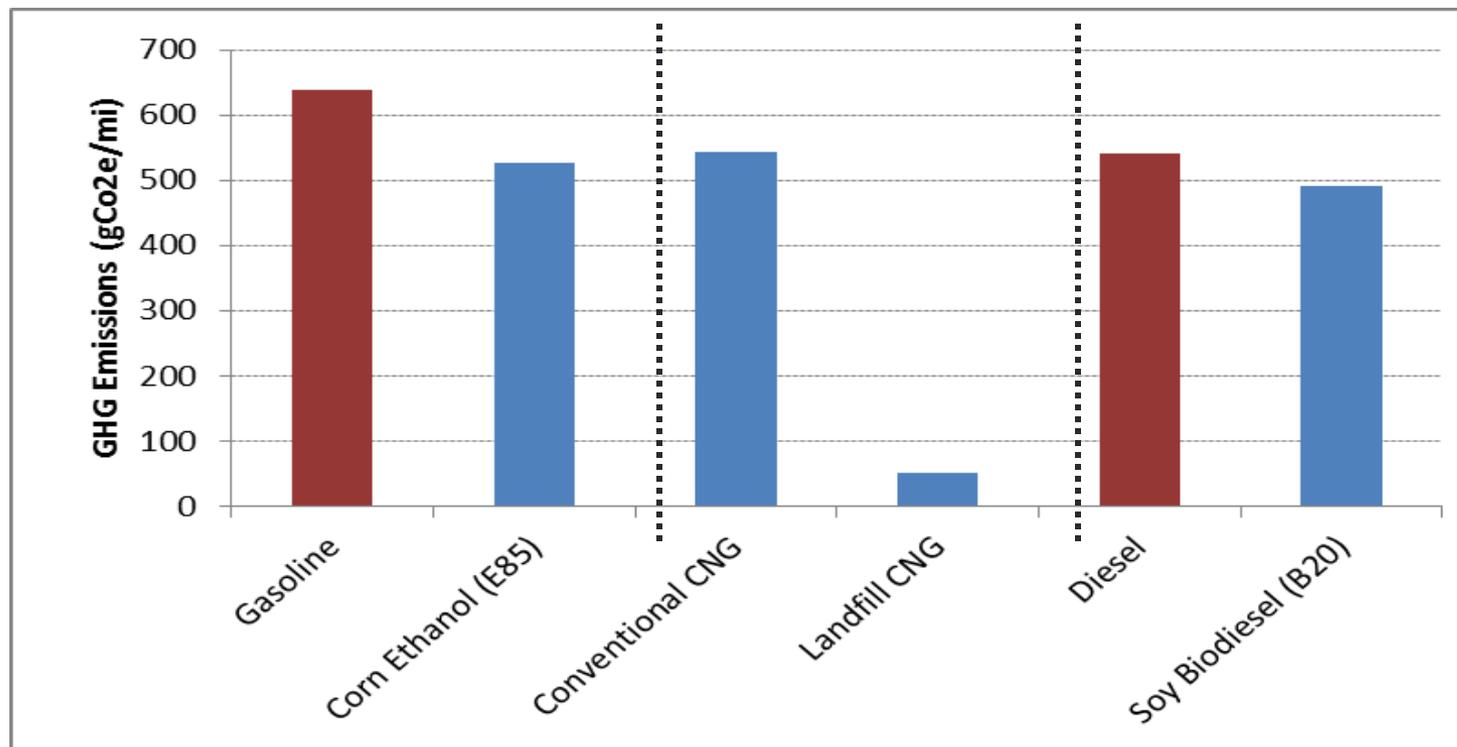
The GREET Model

(Greenhouse gases, Regulated Emissions, and Energy use in Transportation)

- **Includes emissions of greenhouse gases**
 - CO₂, CH₄, and N₂O
- **Estimates emissions of six criteria pollutants**
 - Total and urban separately
 - VOC, CO, NO_x, SO_x, PM₁₀, and PM_{2.5}
- **Separates energy use into:**
 - All energy sources (fossil and non-fossil)
 - Fossil fuels (petroleum, natural gas, and coal combined)
 - Petroleum
 - Natural gas
 - Coal
- **Model and its documents are available at <http://greet.es.anl.gov/>**
 - There are more than 14,000 registered GREET users worldwide



GHG Emissions Comparison of Natural Gas and Other Fuels



- Results shown are WTW for light trucks averaging 14.7 mpge
- Key assumptions include fuel efficiency of NGVs, CH₄ leakage throughout pathway, and timeframe of global warming potential
- California's Low Carbon Fuel Standard estimates better NGV efficiency and less leakage, therefore a greater benefit compared to gasoline and diesel

Natural Gas Vehicles Can Reduce Criteria Pollutants



- **European Bank for Reconstruction and Development study* estimated the emission benefits of 200 CNG buses in Almaty**
 - Nitrogen oxides reduced 222 tons per year
 - Carbon monoxide reduced 78 tons per year
 - Non-methane hydrocarbons reduced 28 tons per year
 - Particulates reduced 15 tons per year
- **Almaty diesel buses have EURO 1 and EURO 2 engines but due to maintenance and fuel quality issues (e.g. kerosene adulteration) emissions in practice are equal to or worse than EURO 0 engines.**
- **New CNG buses assumed to meet EEV standard (between EURO 5 and EURO 6)**
 - Might be conservative as IVECO results show greater benefits for CNG engines

*ROM Transportation, 2010, "Almaty Bus Sector Reform Project: Technical Due Diligence," Prepared for European Bank for Reconstruction and Development



- **Fine particulates are known to be especially damaging, while ozone, carbon monoxide, and other pollutants have lesser effects**
 - Effects can range from itchy eyes to chronic lung disease and heart failure
- **To evaluate health benefits need to:**
 - Estimate changes in exposure to pollution
 - Relate changes in exposure to changes in health effects
 - Relate changes in health effects to changes in economic welfare
- **Large uncertainties are involved throughout this process and obviously results are specific to local conditions**



- **However we can get a general feel of the benefits (results based on U.S. study*) using the emissions reductions in the previous slide**
 - Nitrogen oxide reductions by 222 tons/year
~ \$4,000,000/year
 - Carbon monoxide reductions by 78 tons/year
~ \$6,000/year
 - Non-methane hydrocarbon reductions by 28 tons/year
~ \$36,000/year
 - Particulate reductions by 15 tons/year
~ \$2,200,000/year

*McCubbin and Delucchi, 1999, "Health Costs of Motor-Vehicle-Related Air Pollution," Journal of Transport Economics and Policy, Vol. 33 Pt. 3

What is U.S. DOE Clean Cities?

A voluntary, locally based industry/government partnership

Established Network of Coalitions

- Coordinated by U.S. Department of Energy, with Argonne as one of the lead laboratory's for Clean Cities support
- ~100 coalitions & partnerships in 47 states, covering 78% of the U.S. population
- Builds markets for cleaner-burning CNG and other alternative fuel vehicles to reduce dependence on petroleum
- Fleet customers primary audience
- International effort



Alternative Fuels

Electric Vehicles
Biodiesel
Ethanol
Hydrogen
Propane
Natural Gas

Idle Reduction

Heavy-Duty Trucks
School & Transit Buses
Light-Duty Vehicles



Fuel Economy

More fuel efficient vehicles,
adopting smarter driving and
vehicle purchasing habits



Hybrids

Light- and heavy-duty
Electric hybrids
Plug-In hybrids
Hydraulic hybrids



**Local Strategy to
Advance a
National Goal**



**Coordinators and
Coalitions**

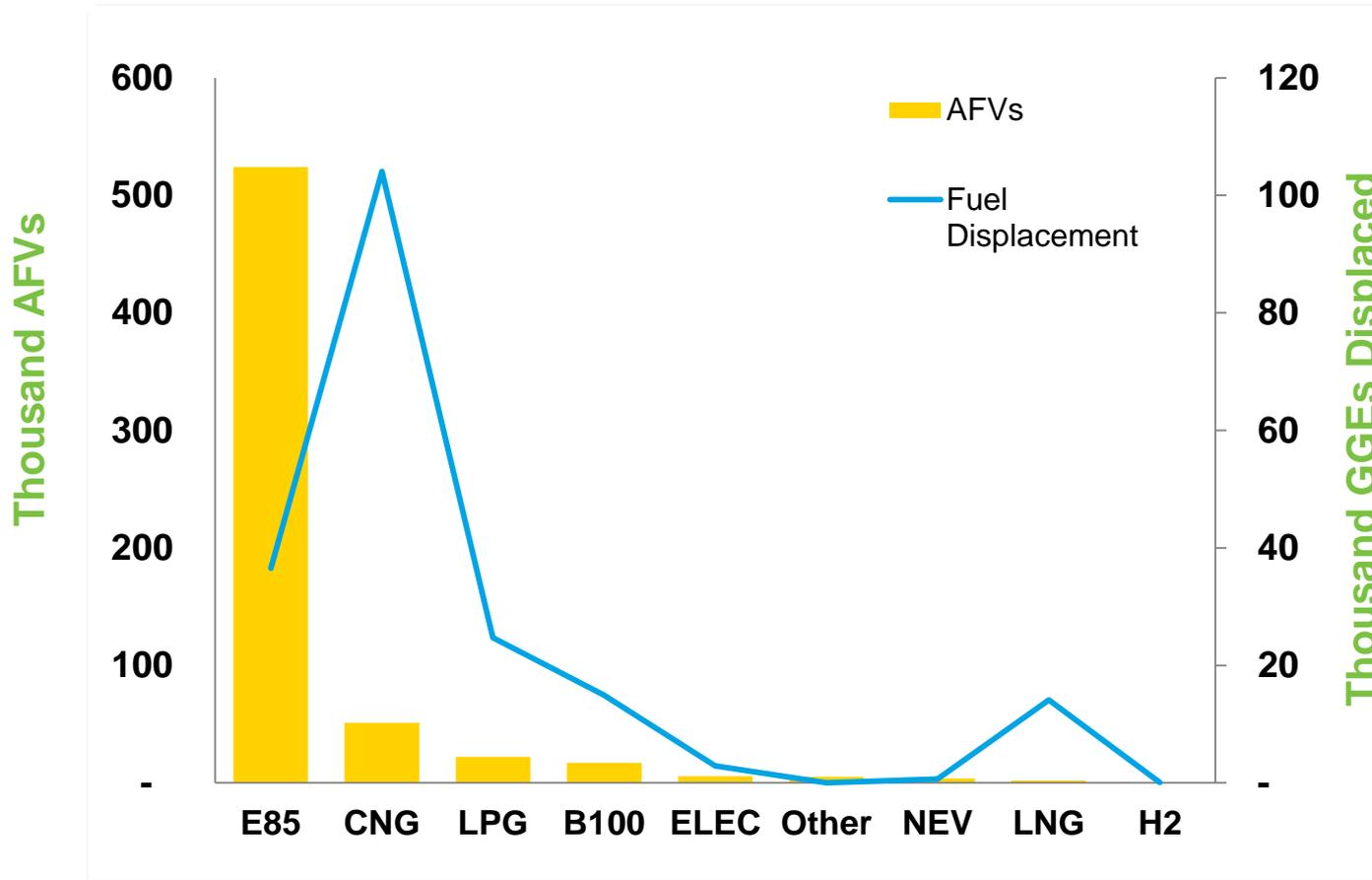


**Technical
Information and
Resources**

- **Coalitions are made up of local and national stakeholders**
 - Stakeholders from businesses, city & state governments, transportation industry, community organizations, fuel providers, fleet operators, such as transit
- **49% private sector**
- **775,000 AFVs using alternative fuels**
- **6,600 AFV stations**
- **8,400+ stakeholders**



Number of AFVs and Fuel Displacement by Fuel Type



Source: Clean Cities Annual Metrics Report 2008, August 2009

Major Increase in Alternative Fuel Transit Buses

- Most established niche market for natural gas
- Compressed Natural Gas (CNG) bus purchases often 20 to 25 percent of annual U.S. transit bus sales in past 10 to 15 years.*
- CNG in transit fleets has reduced consumption of petroleum by over 200,000,000 gal/yr.*
- Coalitions responsible for > half
- Clean Cities sponsors the Transit and School Bus Users Forum



Other Accomplishments

- Clean fuel corridors
- Greening of National Parks
- Fuel Economy Promotion
- Web sites and Tools

* Source: Rob Adams, Marathon Technical Services, October, 2010

Consumer Education & Outreach: Clean Cities Web Resources




Spanish Resources
Publications and Web tools
available in Spanish ▶

U.S. DEPARTMENT OF **ENERGY** | Energy Efficiency & Renewable Energy

Clean Cities

About the Program | Coalitions | Coordinator Toolbox | Financial Opportunities | Information Resources

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Clean Cities strives to advance the nation's economic, environmental, and energy security by supporting local decisions to adopt practices that contribute to the reduction of petroleum consumption. Clean Cities has a network of approximately 90 volunteer coalitions, which develop public/private partnerships to promote alternative fuels and advanced vehicles, fuel blends, fuel economy, hybrid vehicles, and idle reduction.

Clean Cities is part of the Office of Energy Efficiency and Renewable Energy's [Vehicle Technologies Program](#).

Select Coalition-Related Information

- Starting Coalitions
- Coalition Locations
- Program Contacts
- Coordinator Contacts

What is Clean Cities? Fact Sheet (PDF 2 MB) | Download Adobe Reader | Printable Version

Clean Cities

Alt Fuels and Advanced Vehicles Data Center (AFDC)

U.S. DEPARTMENT OF **ENERGY** | Energy Efficiency & Renewable Energy

Alternative Fuels & Advanced Vehicles Data Center

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The Alternative Fuels and Advanced Vehicles Data Center (AFDC, formerly known as the Alternative Fuels Data Center) provides a wide range of information and resources to enable the use of alternative fuels (as defined by the Energy Policy Act of 1992), in addition to other petroleum reduction options such as advanced vehicles, fuel blends, idle reduction, and fuel economy.

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FuelEconomy.gov

www.fueleconomy.gov

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United States Department of Energy | Energy Efficiency and Renewable Energy | United States Environmental Protection Agency

FIND AND COMPARE CARS...

Gas mileage (MPG), greenhouse gas emissions, air pollution ratings, and safety information for new and used cars and trucks

- Compare Side-by-Side
- Advanced Search

Why is fuel economy important?
Climate Change
Strengthen National Security

Diesel Vehicles
- High Tax Incentives
- Biodiesel

Gas Mileage Tips
Driving More Efficiently
Drive Smarter Challenge

Hybrid Vehicles
How Hybrids Work
Tax Incentives

CARS
car allowance rebate system

Trade in your old, inefficient vehicle for a new, more efficient one.

Also known as the "Cash for Clunkers" Program

YOUR MPG ...

Videos
Extreme MPG
Motorweek Videos

Alternative Fuel Vehicles
Flex-Fuel Vehicles

In the News...

Electric Cars' MPG Conundrum - BusinessWeek

More Are Hired to Speed Up the Clunker Reimbursements - The New York Times

Scion dealers say tiny iQ is coming in 2010 - AutoWeek

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- [HEVs](#)
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Search alternative fuels and advanced vehicles publications database.



GREET Fleet Footprint Calculator ▶
Evaluate life-cycle petroleum use and GHG emissions.



Alternative Fueling Station Locator ▶
Find alternative fueling station locations.



State Information Search ▶
Find alternative fuel and advanced vehicle information by state.



Mobile Alternative Fueling Station Locator ▶
Find alternative fueling stations on your mobile device.



Incentives and Laws Search ▶
Search the U.S. incentives and laws database.



Total Stations Count ▶
Find the number of fueling stations in the U.S. by fuel type.



TransAtlas ▶
Explore an interactive map displaying alternative fuel and vehicle data.



Fleet Experiences Search ▶
Browse fleet experience stories by category.



NGV Natural Gas Vehicle Cost Calculator ▶
Compare costs of NG vehicles to conventional vehicles.



Coalition Location Map ▶
Find coalition contact information by state.



Related Links Search ▶
Generate a list of fuel and vehicle Web sites by category.



Heavy-Duty Vehicle Search ▶
Find and compare alternative fuel heavy-duty vehicles, engines, or hybrid propulsion systems

Access all of the tools and information at
http://www.afdc.energy.gov/afdc/info_resources.html



- Established the first international “clean city” Santiago, Chile
- Fostered stakeholders and coalition development in India with the Indian Auto LPG Coalition
- Educated nearly 860 technicians, drivers, policymakers, and educators on alternative fuel vehicles to ensure effective and safe programs
- Met with stakeholders from 12 countries on U.S. trade and technology tours to increase partnership opportunities and to promote global adoption of alternative fuel vehicles
- Sent technical experts all over the world (e.g., codes and standards review in Bangladesh and alternative fuel station assessment in Manila)
- Co-sponsored a mini-trade show on U.S. alternative fuel vehicle technologies in Dhaka
- Hosted workshops on “How To Join Clean Cities” at National Clean Cities conferences and in Bangladesh, Mexico, and the Philippines

Another Example of Collaboration at National Level

IAC Stakeholders



A unique coalition with all the critical stakeholder groups working together closely

Clean Cities Website

www.eere.energy.gov/ccities/

Clean Cities Coordinators

www.eere.energy.gov/cleancities/progs/coordinators.php

Alternative Fuels & Advanced Vehicles Data Center

www.eere.energy.gov/afdc

DOE EERE Information Center and Technical Response Service

Website: <http://www.eere.energy.gov/afdc/informationcenter.html>

Phone: 1-800-EERE-INF (1-877-337-3463)

E-mail: technicalresponse@icfi.com

Hours: 9:00 a.m. – 6:00 p.m. EST

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COMPOSITES**
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Clean Cities Coalitions



* Connecticut Clean Cities Include:
 - Norwich
 - New Haven
 - Connecticut Southwestern Area
 - Capitol Clean Cities of Connecticut

Map Date - 12/09/10



Six Steps to a Sustainable Alternative Fuel Transportation Market

Clean Cities Model

- **Step 1:** Form a coalition and hold stakeholder meetings
- **Step 2:** Appoint a coordinator
- **Step 3:** Establish stakeholder commitments
- **Step 4:** Develop a program plan or (Roadmap)
- **Step 5:** Officially Launch a coalition
- **Step 6:** Implement the program plan



Clean Cities Deployment Efforts Include 4 Major Activities



Local Community/Coalition Support & Partnership Development:

Direct support for CC activities, public events, training for Clean Cities coalitions & community leaders, local project coordination, strategic planning assistance



Consumer Information, Outreach, and Education:

Fuel Economy Guide, Alternative Fuel and Advance Vehicles Data Center (AFDC), other web based consumer tools, publications, workshops, targeted workforce and end-user education



Technical & Problem Solving Assistance:

Addressing Market Barriers, Safety Issues, Technology shortfalls



Financial Assistance:

Funding to Facilitate Infrastructure Development and Vehicle Deployment projects (Competitive Awards)

An Example of Coalition Organization & Governance



- **Tucson Clean Cities is a non-profit program housed at Pima Association of Governments, the metropolitan planning organization for Pima County.**
- **The coalition is made up of both dues paying and non-dues paying stakeholders.**
- **Coalition meetings are held bi-monthly to discuss current projects, give updates on coalition member activities, and hear presentations on topics related to alternative fuels.**
- **There are two co-chairs that assist with coalition meetings**
 - Marc Lappitt, Amphitheater School District
 - Dave Clement, CNG Services of Southern Arizona



Tucson Clean Cities hosts a number of outreach events throughout the year. Some events are nationwide participation & some are local efforts.

- Alternative Energy Expo
- Legislative Breakfast-The Arizona Clean Cities (both Phoenix and Tucson) host the Legislative Breakfast annually on the grounds of the AZ Capitol.
- National AFV Odyssey Day-This event is hosted bi-annually across the nation.
- Annual Day After Thanksgiving Grease Recycling event-Each year collection points are picked to collect grease to be made into biodiesel.
- REVERB-This event is hosted nationally through concert tours. Artists request to run their buses on biodiesel and REVERB works with local outreach efforts to give info on sustainability and alternative fuels
- Radio shows and TV to answer questions for the public

Industry looks to Clean Cities for Product Rollout



Nissan LEAF

- Tucson was chosen as one of five early roll-out locations for the LEAF in December of 2010.
- In March of 2010 Tucson Clean Cities signed an MOU with Nissan North America and ECOtality North America
- In December Tucson welcomed the Nissan LEAF for the “Zero Emission Tour”





- Incentives
- Education and Outreach
- Niche markets are a must, including an anchor fleet
- Simultaneous development of infrastructure and AFVs
- Air quality and energy security are strong drivers
- Program must be flexible to allow local solutions
- Bridging gap between available technologies and market demand requires technical, financial, and policy assistance
- Unbiased data on all available fuels and technologies
- Showcase achievements of fleet managers and recognize them
- **Coordinators are the most important resource available to public decision-makers—Invest in Good Coordinators**
- **Coalitions comprised of the public and private sector will achieve success**

MotorWeek

Television's Original Automotive Magazine

MotorWeek segments provided by Maryland Public Television



NEW! Car Keys - Fuel Sippers

[Flash Video](#) (14.7 MB)

[Quicktime Movie](#) (30.9 MB)

[Text Version \(pdf\)](#)



NEW! Big Green SUVs

[Flash Video](#) (8.5 MB)

[Quicktime Movie](#) (17.9 MB)

[Text Version \(pdf\)](#)



NEW! Best Eco-Friendly Award - GM Hybrid SUVs

[Flash Video](#) (3.4 MB)

[Quicktime Movie](#) (7.3 MB)

[Text Version \(pdf\)](#)

Partnered with National Media:

- Collaboration with PBS-TV
- > 50 segments on alt fuels, advanced vehicles, fuel economy
- FuelEconomy.gov uses segments
- Enhanced CC legitimacy among automotive journalists

Natural Gas Vehicle Projects Featured:

- Colonial Williamsburg
- New York City Dept. of Sanitation
- Empire Coachworks
- Solid Waste Authority of Central Ohio
- . . . and many more!

Videos available at

<http://www.afdc.energy.gov/afdc/videos.html>

Consumer Education & Outreach: Clean Cities Web Resources




Spanish Resources
Publications and Web tools
available in Spanish ▶

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Strengthen National Security

Diesel Vehicles
- High Tax Incentives
Biodiesel

Gas Mileage Tips
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More Are Hired to Speed Up the Clunker Reimbursements - The New York Times

Scion dealers say tiny iQ is coming in 2010 - AutoWeek

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TransAtlas ▶
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NGV Natural Gas Vehicle Cost Calculator ▶
Compare costs of NG vehicles to conventional vehicles.



Coalition Location Map ▶
Find coalition contact information by state.



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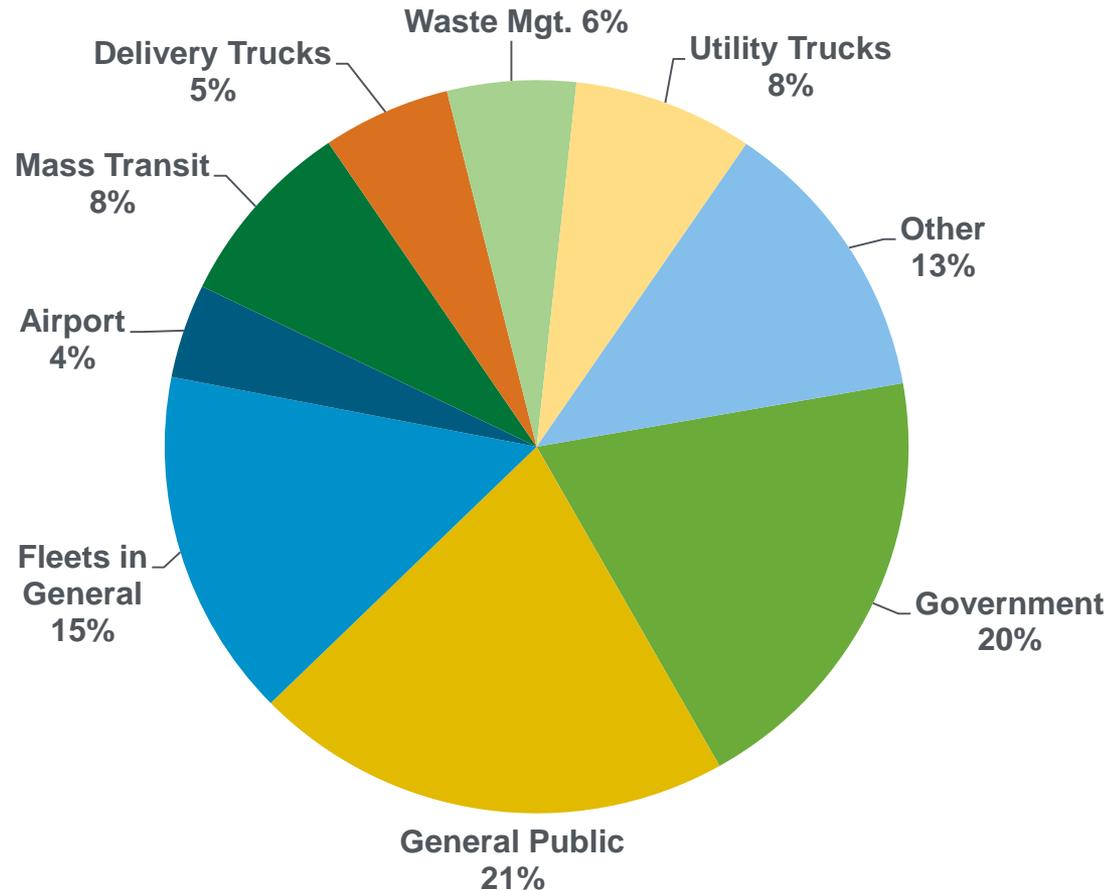
Access all of the tools and information at
http://www.afdc.energy.gov/afdc/info_resources.html

Results for the Seven Types of Outreach Activities

Activity Type	Persons Reached	% of All People Reached	No. of Activities	% of All Activities
Media Event	90,193,899	79.6%	191	15%
Advertisement	20,106,562	17.7%	27	2%
Web Site	1,088,881	1.0%	18	1%
Literature Distribution	862,777	0.8%	254	19%
Advancing the AFV Choice	655,252	0.6%	181	14%
Legislation	304,580	0.3%	31	2%
Meeting	66,167	0.1%	608	46%
Total All Types	113,278,118	100.0%	1,310	100%

- **1,310 activities reaching over 113 million people**
- **3X increase from 2007**

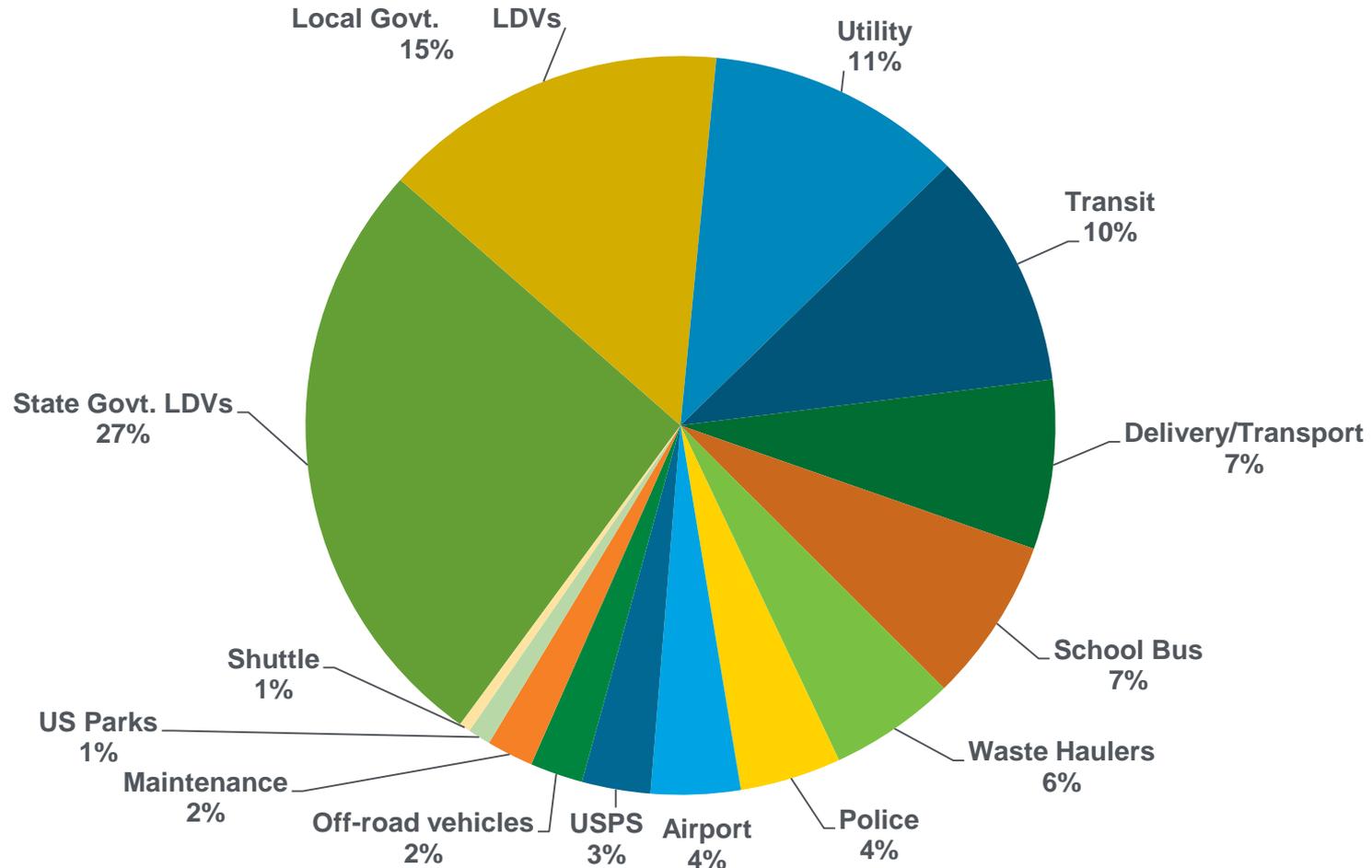
Number of Outreach Activities Split among Audience Types



Effective signage is essential to communicating and promoting information on alternative fuel vehicles.



Percentage of Total AFVs and HEVs by Niche Market



Source: Clean Cities Annual Metrics Report 2008, August 2009

Recognize Champions



Clean Cities Coordinators: Local Champions for Alternative Fuels

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