

Gaseous Fuels: What's Here and What's Coming

Marianne Mintz

Green Truck Summit

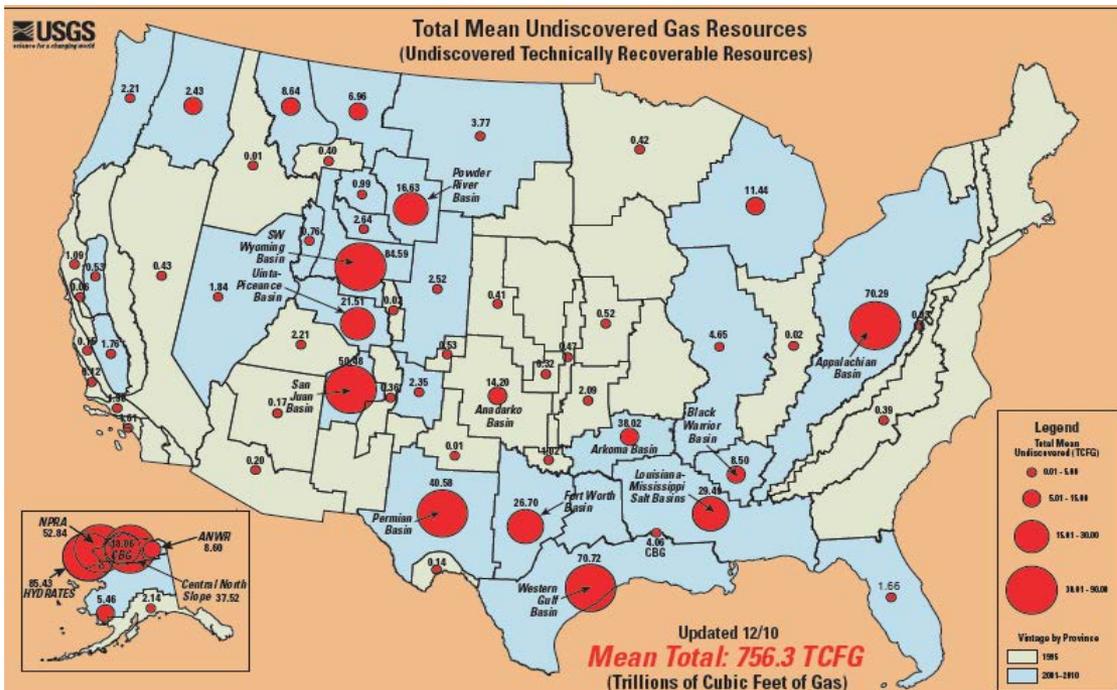
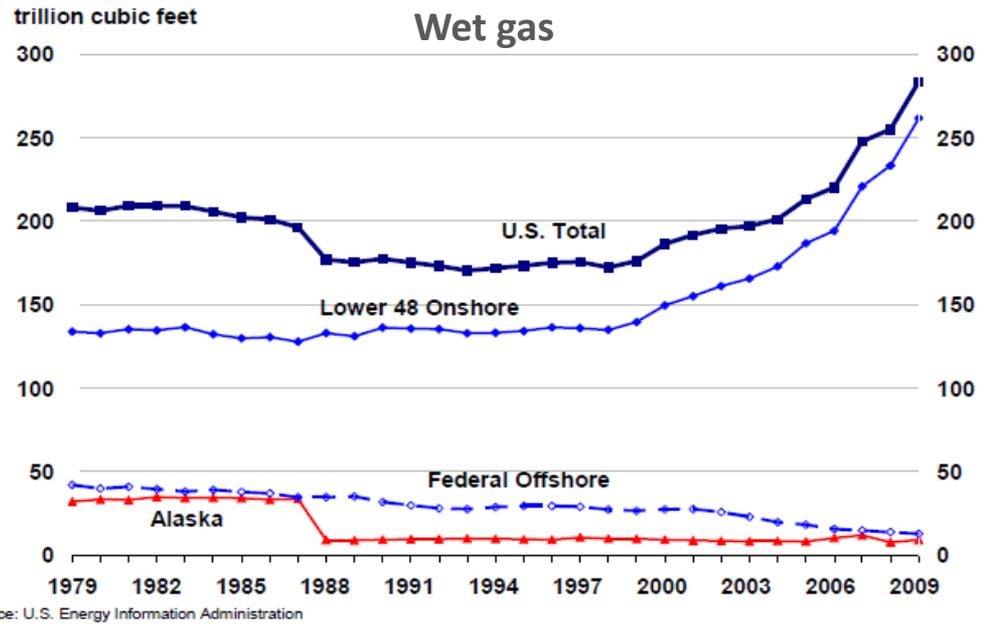
March 8, 2011

Presentation Overview

- ❑ Natural gas supplies
- ❑ Natural gas vehicles/engines
- ❑ Infrastructure/station availability and resources

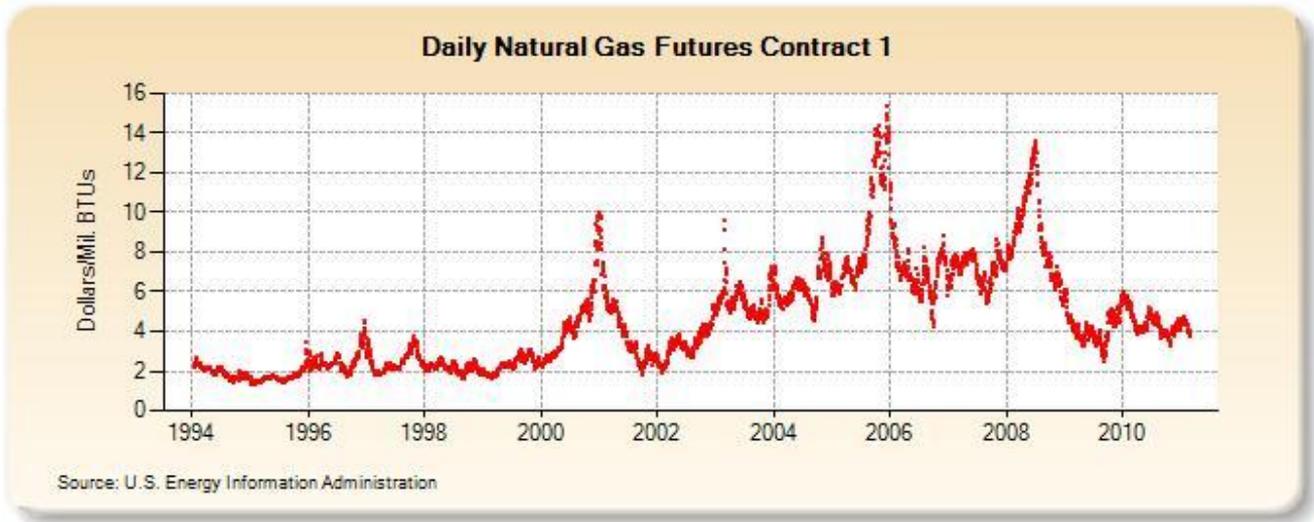


US natural gas (NG) reserves have grown dramatically in the past decade



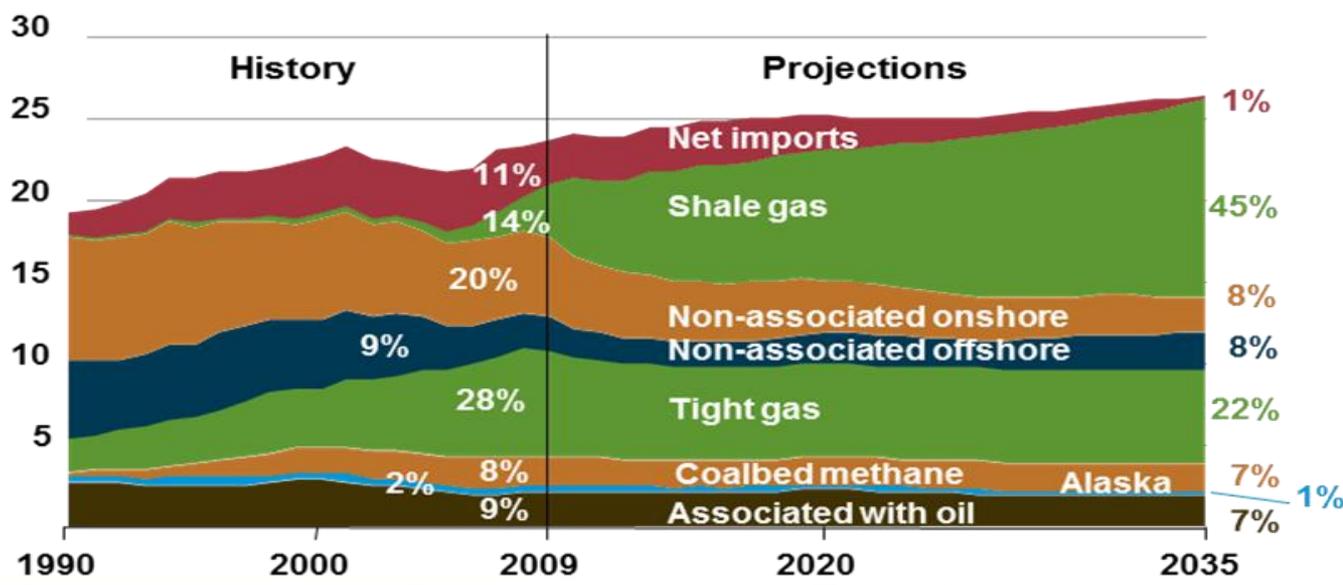
Nearly doubling estimated technically recoverable resources

NG price has stabilized as new sources come on line

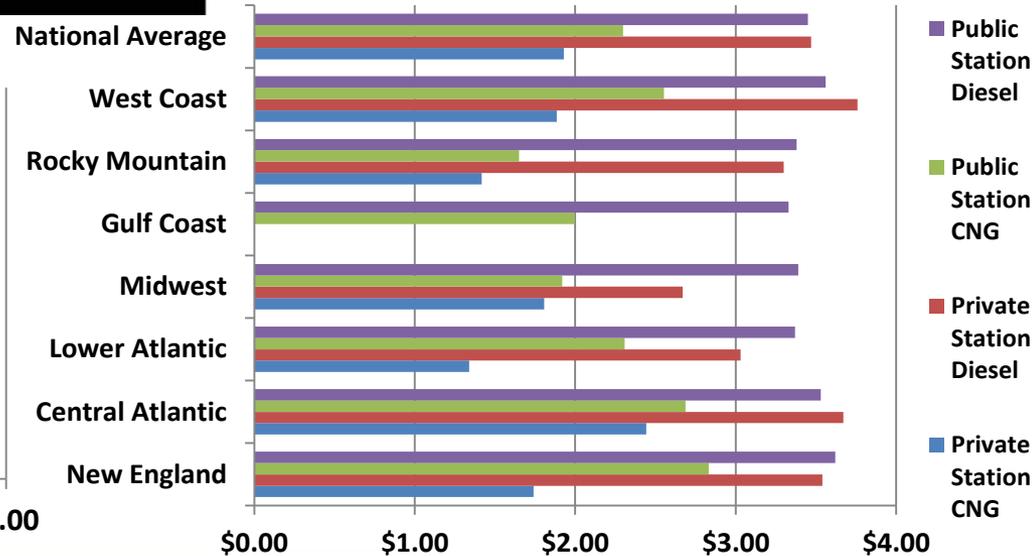
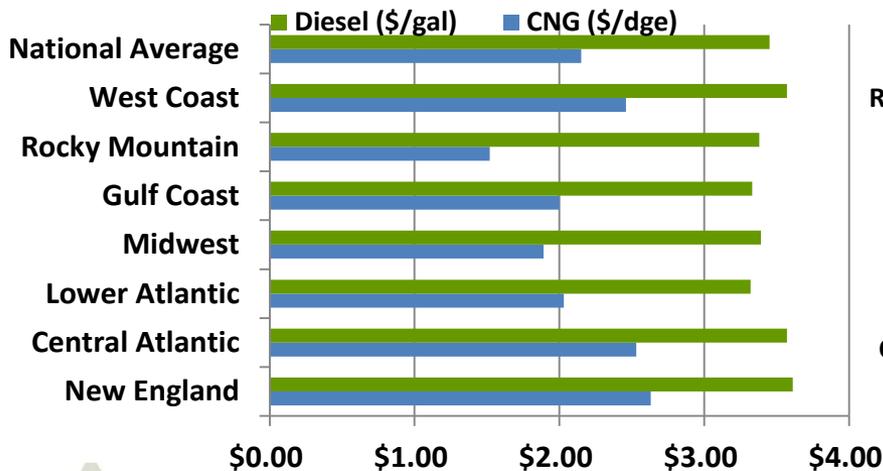
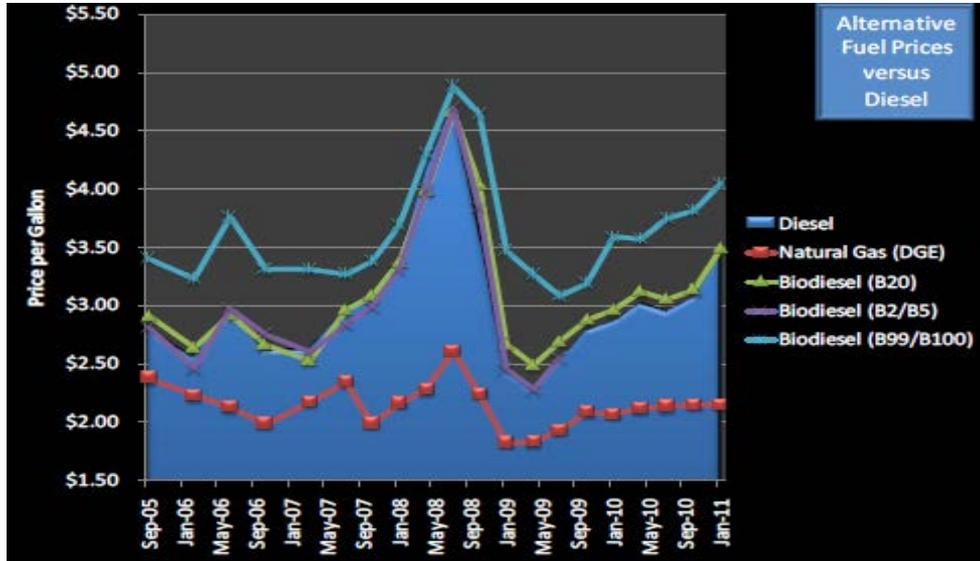


Shale/tight sands offset declines in conventional supplies

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



CNG costs ~\$1.50/gal equivalent less than diesel nationally; ~\$2 less in Mountain West



In addition to fossil NG, renewable natural gas (RNG) can be produced from

- Landfills (LFG)
- Organic matter from plants or animals
- Wastewater
- Food waste



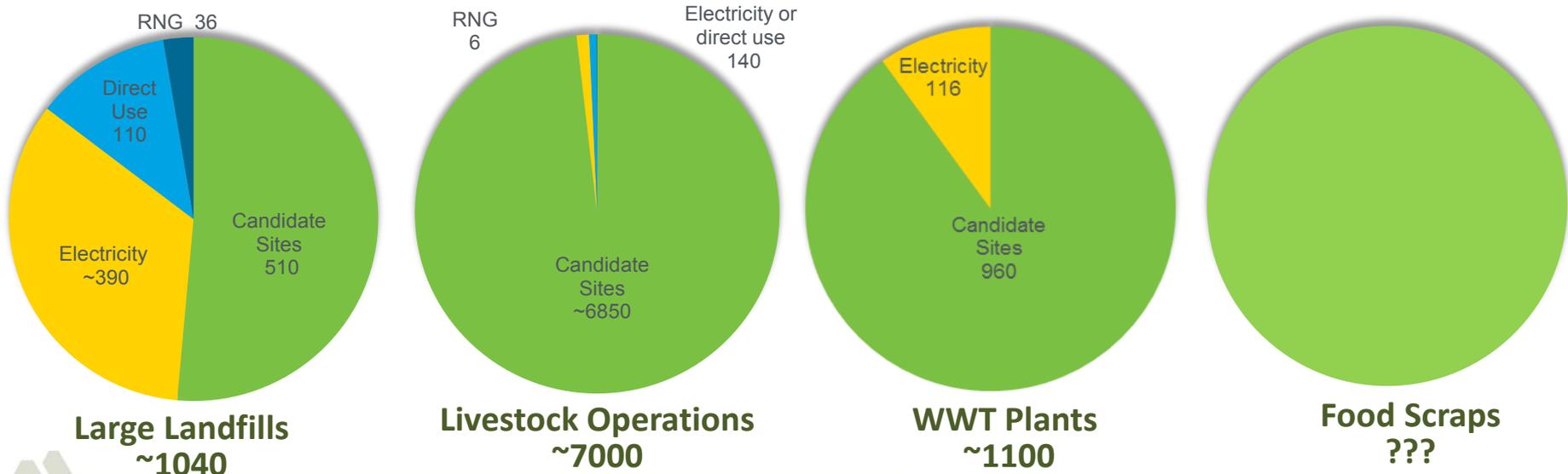
RNG sources are plentiful & largely untapped

❑ Large sources of organic waste

- Landfills with ≥ 2.5 million m³ waste-in-place & LFG collection systems
- Dairy farms with ≥ 500 head; swine farms with ≥ 2000 head
- Wastewater treatment (WWT) plants serving $\geq 50,000$ people (≥ 5 MMGPD inflow)
- Food services, food processors and other industrial sources

❑ Vast majority of operational projects produce electricity

❑ Half of candidate large landfills recover LFG, ~2% of dairy/swine farms and ~10% of large WWT plants recover gas; little data on other wastes



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)	Refuse truck Transit/school Street sweeper Yard hostler
Doosan Infracore America	11 L (GX 12-S)	SI Lean burn with SCR (285)	Refuse truck Transit bus
Emission Solutions	7.6 L (Phoenix NG)	SI Stoichiometric (176-275)	School/shuttle Work truck
Westport Innovations	15 L (GX) (95% LNG/5%LSD)	HPDI Pilot Ignition (400-450)	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.

Source: Rood-Werpy et al., *Natural Gas Vehicles: Barriers, Status and Opportunities*, ANL/ESD/10-4, August 2010.

NG Information Resources are available on DOE/Clean Cities-Sponsored Web Sites

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](#)
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What is Clean Cities? Fact Sheet (PDF 2 MB)
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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.

This site is sponsored by the U.S. Department of Energy's [Clean Cities](#) initiative.



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AFDC

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Especially the Alternative Fuels and Advanced Vehicles Data Center (AFDC)

The screenshot shows the AFDC website interface with the following elements:

- Header:** U.S. DEPARTMENT OF ENERGY Energy Efficiency & Renewable Energy. Alternative Fuels & Advanced Vehicles Data Center.
- Navigation:** About the AFDC, Fuels, Vehicles, Fleets, Incentives & Laws, Data, Analysis & Trends, Information Resources.
- Search:** Search Help, More Search Options, Site Map, EERE Information Center.
- Main Content:**
 - Alternative Fuel Portals:** Biodiesel, Hydrogen, Electricity, Natural Gas, Ethanol, Propane.
 - Select Vehicle Information:** Conversions, HEVs, Emissions, Plug-in Hybrids, Fuel Economy, Idle Reduction.
 - Quick Links to AFDC Tools:** Light-Duty Vehicle Search, Heavy-Duty Vehicle Search, Alternative Fueling Station Locator, Incentives & Laws, Publications Search, State Information.
 - AFDC Tools:** Clean Cities 2009 Petroleum Reduction Projects, TransAtlas, Clean Cities.
- Footer:** Data, Analysis, and Trends section provides industry trends and facts based on data analysis. Printable Version.

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.

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

Fleet Experiences Search ▶
Browse fleet experience stories by category.

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

Publications Search ▶
Search alternative fuels and advanced vehicles publications database.

Coalition Location Map ▶
Find coalition contact information by state.

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

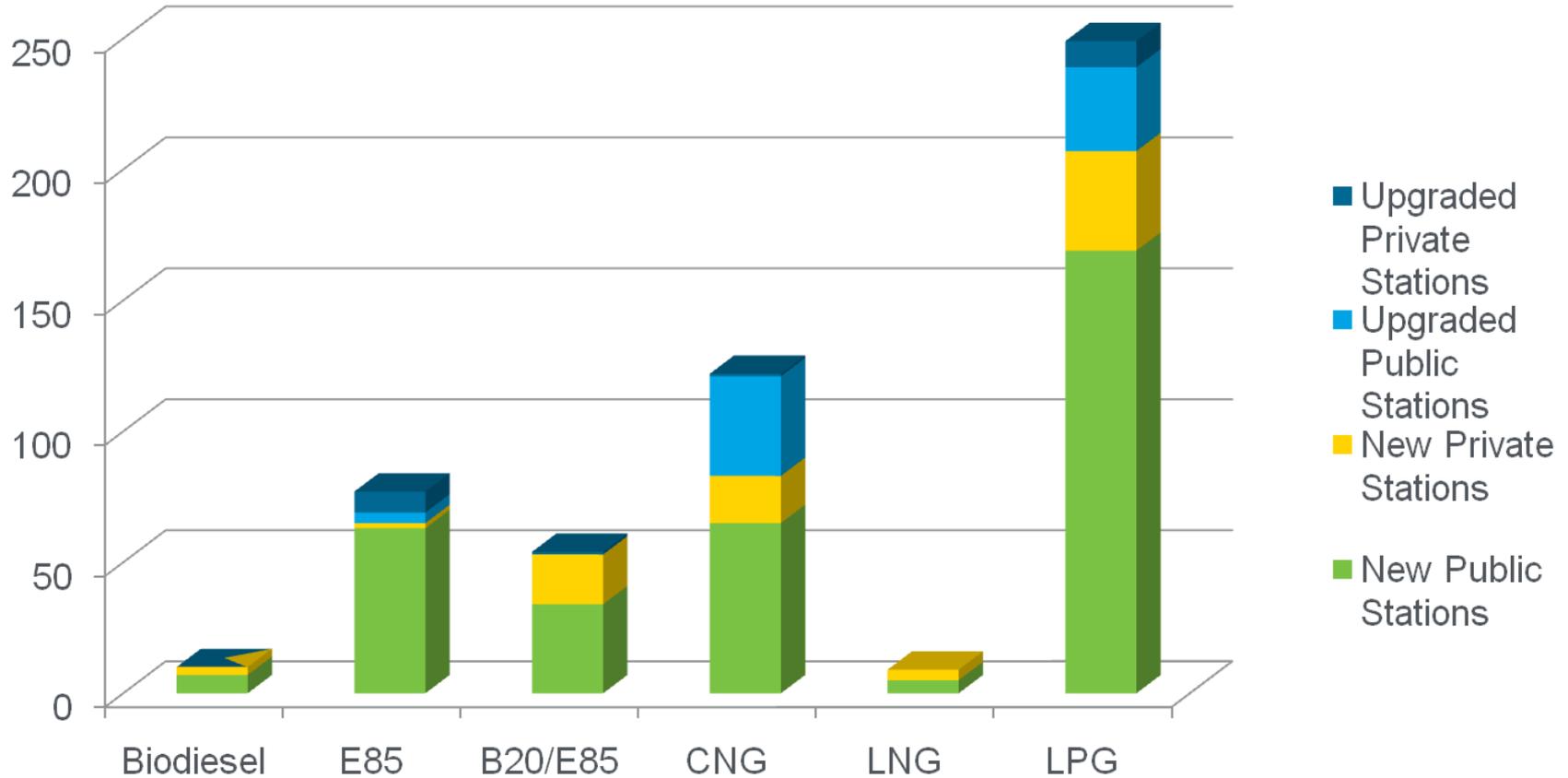
GREET Fleet Footprint Calculator ▶
Evaluate life-cycle petroleum use and GHG emissions.

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

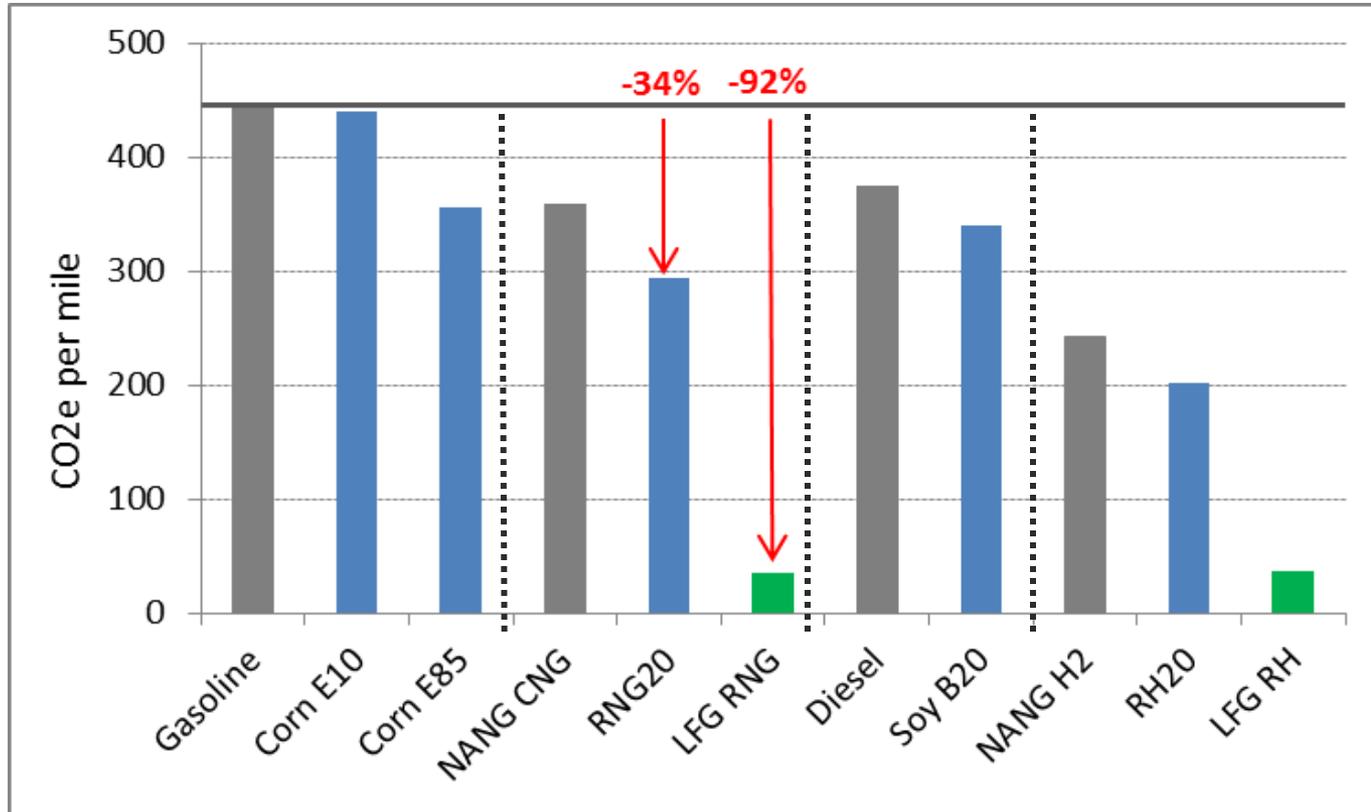


Recovery Act funding is putting ~370 new alternative fuel stations into operation

More than 2,000 alternative fuel refueling or charging stations will be installed or upgraded —
1,564 electric charging stations, 122 CNG stations and 9 LNG/LCNG stations



NG, RNG and RNG blends have significant GHG reductions relative to gasoline



Source: Argonne National Laboratory, GREET model

- ❑ Results shown are WTW for light trucks averaging 17.3 mpge
- ❑ Dotted lines separate gasoline/ethanol, natural gas, diesel and H2 fuels
- ❑ Percent reductions are relative to a gasoline reference pathway

Thank you

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