

VIRGINIA CLEAN CITIES

Overview



VIRGINIA CLEAN CITIES



VIRGINIA

Clean Cities

- National US DoE voluntary program to promote energy independence in transportation
- 90 Coalitions nationwide
- One designated Coalition in Virginia (Hampton Roads)
- Statewide effort ongoing



DoE Website:

<http://www.eere.energy.gov/cleancities/>

Virginia Clean Cities:

<http://www.hrccc.org>



DOE Alternative Fuels
Data Center

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

Map Date: 9.7.04

Transportation Oil Gap

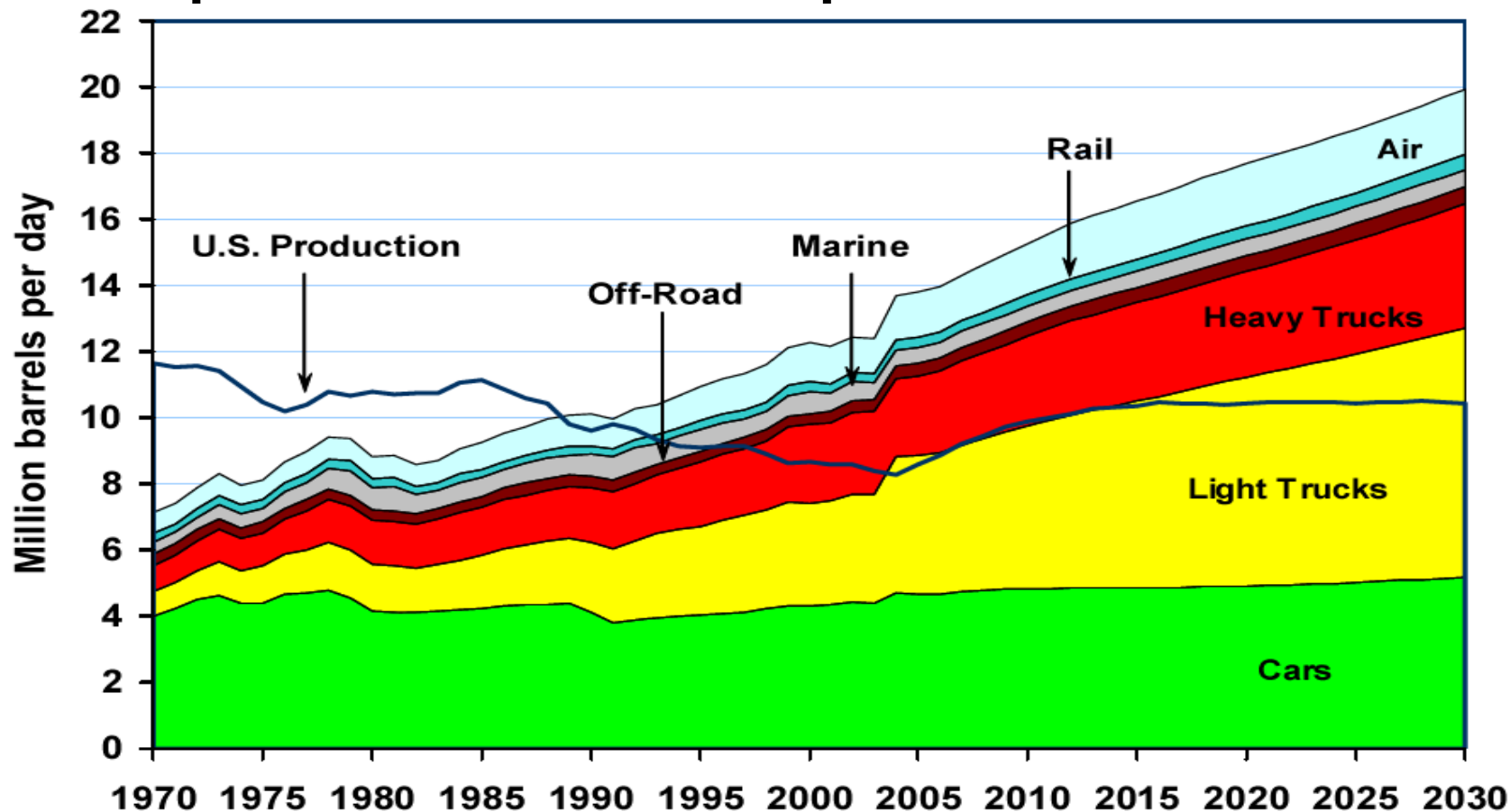


Figure 1.6. United States Petroleum Production and Consumption, 1970–2025



Alternative Fuels—Partial Solution

- Domestically produced
- Derived from renewable sources
- Reduced harmful pollutants and CO₂

And not on top of the solutions list



Conservation is best “alternative:”

- Faster, Cheaper, Easier
 - (compared to everything else we will talk about)
- Conservation includes:
 1. Demand reduction
 2. Efficiency improvement
 3. Reality check (3rd element of conservation)
 1. Can we support a single-occupant vehicle lifestyle?
 2. Will we stop sprawling, unplanned land use?
 3. Will we make mass transit work?

We might be oil-dependent for decades



But we do have non-fossil (and “clean” fossil) choices.

What were mine today?....

VIRGINIA CLEAN CITIES

www.fueleconomy.gov



www.fueleconomy.gov Links | FAQ | Site Map | Search | Contacts

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
- Search by Class

YOUR MPG ...

With 'Your MPG' you can:

- Calculate and Share 'Your MPG'
- View MPG Estimates from Drivers Like You

Diesel Vehicles

Tax Incentives
Biodiesel

Gasoline Prices

Find the Lowest Prices
Frequently Asked Questions

Gas Mileage Tips

Driving More Efficiently
Drive \$marter Challenge

Hybrid Vehicles

How Hybrids Work
Tax Incentives

Videos

Extreme MPG
Motorweek Videos

Alternative Fuel Vehicles

Flex-Fuel Vehicles
How Fuel Cells Work

New Fuel Economy Ratings

How Vehicles are Tested
Your MPG Will Vary

Find Your Car's Energy Impact Score

Why is fuel economy important?

Fuel Cost Calculator
Strengthen National Security

Gasoline - Ethanol Vehicles

Find a Flex-Fuel Vehicle
Where can I buy E85?

In the News...

Prius Diary Extra: Toyota Considering a Separate Prius Brand - The New York Times
Thermoelectrics could boost gas mileage - United Press International
Honda shows off new Insight hybrid at Paris auto show - USA Today

[Disclaimer](#) [More News](#)

fueleconomy.gov/m

Find and Compare Cars on Your Mobile Device

NEW MPG RATINGS FOR 2008

We have revised the 1985-2007 MPG estimates to make them comparable to EPA's new 2008 MPG ratings.

- New 1985-2009 MPG estimates
- Print the Fuel Economy Guide

Model	2007 EPA	2008 EPA
2007 Ford Focus	24	26
2008 Ford Focus	26	28
2007 Honda Civic	24	26
2008 Honda Civic	26	28
2007 Toyota Camry	24	26
2008 Toyota Camry	26	28

- Compare fuel economy
- Compare emissions
- Includes AFVs

Sport Utility Vehicle



- Tahoe 1995
- EPA rated 11/14
- \$5.94 fuel cost @ \$3.09 to drive 25 miles
- 26.3 barrels of petroleum for 15,000 annual miles
- 14.1 tons of CO₂

VIRGINIA CLEAN CITIES

Sport Utility Vehicle



- Tahoe 2009
- EPA rated 14/20
- \$4.29 fuel cost @ \$3.09 to drive 25 miles
- 19 barrels of petroleum for 15,000 annual miles
- 10.2 tons of CO₂

VIRGINIA CLEAN CITIES

Sport Utility Vehicle



- FFV version
- Tahoe 2009
- EPA rated 10/15
- \$4.14 fuel cost @ \$2.32 to drive 25 miles
- 5.7 barrels of petroleum for 15,000 annual miles
- 7.9 tons of CO₂

Ethanol Properties

- Alcohol-based fuel produced from starch crops or cellulosic biomass (trees and grasses). Currently, corn is primary feedstock.
- High octane (100+); enhances octane properties of gasoline and used as oxygenate to reduce CO emissions.
- 27% - 36% less energy content than gasoline. OEM's estimate 15% - 30% decrease in mileage.
- E85 vehicles demonstrate a 25% reduction in ozone-forming emissions compared to gasoline.
- As an alternative fuel, most commonly used in a blend of 85% ethanol and 15% gasoline (E85).

Ethanol Uses

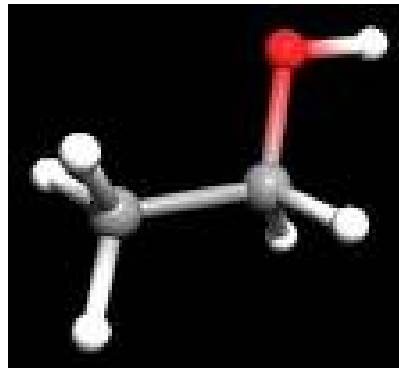
- Mostly used in light-duty vehicles called flexible fuel vehicles (FFVs). FFVs can use 100% unleaded fuel or any mixture of E85 and unleaded fuel.
- Several manufacturers offer FFVs in car and pickup configurations. See the AFDC Web:

www.eere.energy.gov/afdc



Ethanol Considerations

- Decreased mileage.
- High level of fuel pricing volatility until demand and supply balance.
- Refueling infrastructure not in place in all areas (1,800 stations in the U.S. Just more than 1 percent of gasoline stations.)
- Ongoing debate: energy balance, land mass, food and fuel, and water required.



Diesel/Biodiesel



- Diesel
- 2003 Jetta
- EPA rated 29/40
- \$2.43 fuel cost @ \$3.59 to drive 25 miles
- 10.6 barrels of petroleum for 15,000 annual miles
- 8.5 barrels if B20 used
- 5.7 tons of CO₂

VIRGINIA CLEAN CITIES

Diesel/Biodiesel



- Diesel
- 2009 Jetta
- EPA rated 29/40
- \$2.43 fuel cost @ \$3.59 to drive 25 miles
- 10.6 barrels of petroleum for 15,000 annual miles
- 8.5 barrels is B20 used
- 5.7 tons of CO₂
- Qualifies for \$1,300 tax credit
- (advanced lean burn technology)



Biodiesel Properties

- Manufactured from vegetable oils, animal fats, or recycled restaurant greases; reacted with alcohol to produce fatty acid alkyl ester.
- Nontoxic, biodegradable, and reduces serious air pollutants.
- B20 (20% biodiesel, 80% petroleum diesel) can generally be used in unmodified diesel engines.
- Can be used in pure form (B100), but may require engine modifications.
- Has a higher cetane number and provides more lubricity.
- B20 contains 9% less energy content per gallon than #2 diesel.

Biodiesel Uses

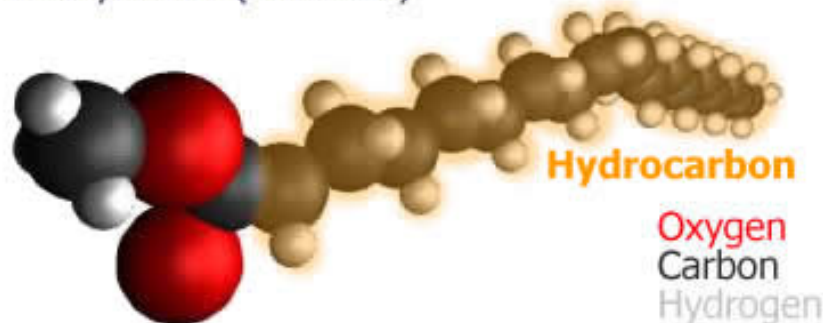
- B20 can generally be used in all unmodified diesel engines.
- Using biodiesel maintains the same payload capacity and range and provides similar horsepower, torque, and fuel economy.



Biodiesel Considerations

- Potential issues with cold starting. Also, cold weather storage requires additional steps to keep biodiesel usable.
- Some OEM warranties specify no blend above B5.
- Limited production and availability.

Methyl Ester (Biodiesel)



VIRGINIA CLEAN CITIES

Natural Gas Vehicle



- NGV
- 2009 Honda GX
- EPA rated 24/36
- \$1.29 fuel cost @ \$1.65 to drive 25 miles
- 0.1 barrels of petroleum for 15,000 annual miles
- 4.7 tons of CO₂



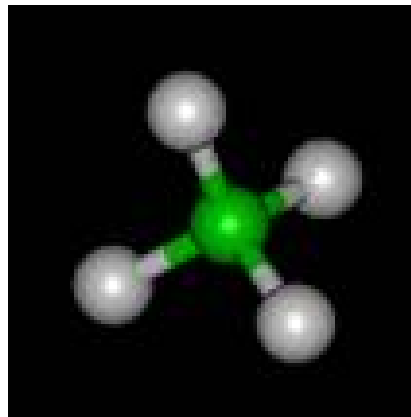
- 2008 Qualified for \$4,000 tax credit
- Home fueling unit eligible for \$1,000 credit

Natural Gas Properties

- Recovered from underground reserves.
- Used in two forms: CNG (compressed natural gas) and LNG (liquefied natural gas).
- CNG and LNG vehicles can demonstrate reduced ozone-forming emissions compared to gasoline. May have increased hydrocarbon emissions.
- Contains 59% - 69% less energy content per gallon at 3000 - 3600 psig than gasoline.
- Widespread distribution infrastructure (but not much retail).

CNG/LNG Uses

- CNG used in light- and medium-duty vehicles.
- LNG used in heavy-duty trucks and all natural gas fueled locomotives.
- CNG stored onboard at 3000 - 3600 psig.
- LNG stored at 50 psig and fuel temperature at -220°F .



CNG/LNG Considerations

- CNG refueling stations are either slow-fill (several hours to fill) or fast-fill (2 - 5 minutes).
- Additional safety modification for maintenance facilities required by NEC (National Electrical Code) and NFPA (National Fire Protection Association).
- Higher vehicle costs because of required tank configuration.
- Shorter vehicle range for CNG vehicles.
- Availability of refueling stations.

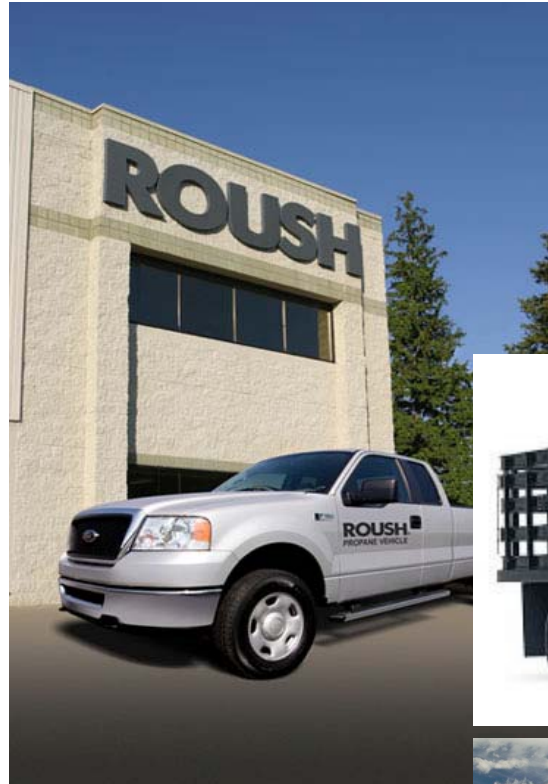


VIRGINIA CLEAN CITIES

Propane powered vehicles



- Largest AFV fleet is propane
- Mostly commercial vehicles



Propane vehicles, fuel and fueling infrastructure qualify for federal tax credits



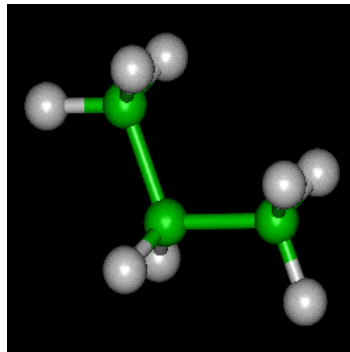


Propane (LPG) Properties

- By-product of natural gas processing and crude oil refining.
- HD5, the automotive propane standard, a mixture of 90% propane and other hydrocarbons.
- Contains 33% - 41% less energy content per gallon than gasoline.
- LPG vehicles can demonstrate a 60% reduction in ozone-forming emissions compared to gasoline.
- High octane properties (~104) allow LPG vehicles to operate with higher compression ratios; leads to higher efficiency/fuel economy.

Propane (LPG) Uses

- Used in light- and medium-duty vehicles, heavy-duty trucks and buses.
- Popular choice for non-road vehicles such as forklifts and agricultural and construction vehicles.
- Many propane vehicles are converted gasoline vehicles. (Conversion kits include regulator/vaporizer, air/fuel mixer, oxygen-monitoring closed-loop feedback system, and special fuel tank.)



Propane (LPG) Considerations

- Widespread infrastructure of pipelines, processing facilities, and storage (2,499 stations in U.S. offered LPG in 2006).
- For vehicles, need to balance range vs. payload reduction caused by larger fuel tanks.
- Increased vehicle costs.



Hybrid Electric Vehicle

- Hybrid
- 2009 Prius
- EPA rated 48/45
- \$1.68 fuel cost @ \$3.59 to drive 25 miles
- 7.4 barrels of petroleum for 15,000 annual miles
- 4 tons of CO₂
- Toyota hit 60,000-vehicle limit for for tax credit, which was \$3,150 at highest point



Hybrid Sport Utility Vehicle

- Hybrid version
- Tahoe 2009
- EPA rated 20/22
- \$3.51 fuel cost @ \$3.09 to drive 25 miles
- 15.6 barrels of petroleum for 15,000 annual miles
- 8.3 tons of CO₂
- **Qualifies for \$2,200 federal tax credit**



VIRGINIA CLEAN CITIES

Low Speed Electric Vehicle

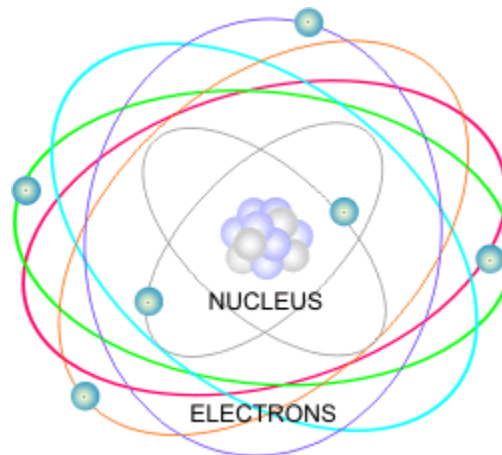


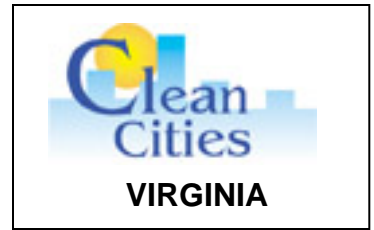
- GEM electric vehicles
- \$87 for power @ \$0.08 per KWH per year for 7,800 annual miles (GEM website calculator)
- \$0.011 per mile
- 28 cents to drive 25 miles



Electricity Properties

- Recharges batteries in electric vehicles.
- Electricity sources for battery recharging (electrical outlet, gasoline engine on-board vehicle, regenerative braking).
- Electricity sources for power outlets (coal, natural gas, nuclear, wind, other renewables).





Electricity Uses

- Two categories include EVs or plug-ins (externally charged) and HEVs or hybrid vehicles (self-charged). Both use battery storage.
- Available in neighborhood electric vehicles, bicycles, light-duty vehicles, medium- and heavy-duty trucks and buses.
- Hybrids use an electric motor or a combination of a gasoline engine and electric motor to drive the wheels. Hybrids use batteries to store electricity produced by regenerative braking and the onboard generator.
- Range of a dedicated electric is typically 50-130 miles.

Electricity Considerations

- Fuel savings (10% - 100% depending on application and vehicle).
- Payback on investment.
- Possible federal and state tax credits for purchase of hybrid.



Comparing 8 vehicles



	1995 Tahoe 4wd gas	2009 Tahoe 4wd gas	2009 Tahoe 4wd FFV	2009 Tahoe 4wd Hybrid	2003 Jetta GTI Diesel	2009 Jetta Lean- Burn	2009 Honda Civic NGV	2009 Toyota Prius Hybrid
MPG (combined)	13	18	14	22	37	37	32	46
Fuel cost (25 miles)	5.94	4.29	4.14	3.51	2.43	2.43	1.29	1.68
Barrels annual	26.3	19	5.7	15.6	10.6	10.6	0.1	7.4
Tons CO2	14.1	10.2	7.9	8.3	5.7	5.7	4.7	4

- Unleaded \$3.09; Diesel \$3.59; E85 \$2.32; CNG \$1.65
- 15,000 annual miles – 75 % highway, 25 % city

Comparing 8 vehicles



	1995 Tahoe 4wd gas	2009 Tahoe 4wd gas	2009 Tahoe 4wd FFV	2009 Tahoe 4wd Hybrid	2003 Jetta GTI Diesel	2009 Jetta Lean- Burn	2009 Honda Civic NGV	2009 Toyota Prius Hybrid
MPG (combined)	13	18	14	22	37	37	32	46
Fuel cost (25 miles)	5.94	4.29	4.14	3.51	2.43	2.43	1.29	1.68
Barrels annual	26.3	19	5.7	15.6	10.6	10.6	0.1	7.4
Tons CO2	14.1	10.2	7.9	8.3	5.7	5.7	4.7	4

- Unleaded \$3.09; Diesel \$3.59; E85 \$2.32; CNG \$1.65
- 15,000 annual miles – 75 % highway, 25 % city

Comparing 8 vehicles



	1995 Tahoe 4wd gas	2009 Tahoe 4wd gas	2009 Tahoe 4wd FFV	2009 Tahoe 4wd Hybrid	2003 Jetta GTI Diesel	2009 Jetta Lean- Burn	2009 Honda Civic NGV	2009 Toyota Prius Hybrid
MPG (combined)	13	18	14	22	37	37	32	46
Fuel cost (25 miles)	5.94	4.29	4.14	3.51	2.43	2.43	1.29	1.68
Barrels annual	26.3	19	5.7	15.6	10.6	10.6	0.1	7.4
Tons CO2	14.1	10.2	7.9	8.3	5.7	5.7	4.7	4

- Unleaded \$3.09; Diesel \$3.59; E85 \$2.32; CNG \$1.65
- 15,000 annual miles – 75 % highway, 25 % city

Comparing 8 vehicles



	1995 Tahoe 4wd gas	2009 Tahoe 4wd gas	2009 Tahoe 4wd FFV	2009 Tahoe 4wd Hybrid	2003 Jetta GTI Diesel	2009 Jetta Lean- Burn	2009 Honda Civic NGV	2009 Toyota Prius Hybrid
MPG (combined)	13	18	14	22	37	37	32	46
Fuel cost (25 miles)	5.94	4.29	4.14	3.51	2.43	2.43	1.29	1.68
Barrels annual	26.3	19	5.7	15.6	10.6	10.6	0.1	7.4
Tons CO2	14.1	10.2	7.9	8.3	5.7	5.7	4.7	4

- Unleaded \$3.09; Diesel \$3.59; E85 \$2.32; CNG \$1.65
- 15,000 annual miles – 75 % highway, 25 % city

VIRGINIA CLEAN CITIES



- FCEV (not for sale)
- HICE (BMW dual fuel)



Chevy Equinox FCEV
H2 Tour Chester stop

Hydrogen Properties

- Does not occur to any significant extent on earth in its free, elemental form.
- Found in chemical compositions such as water and hydrocarbons, and dry coal.
- Pure hydrogen contains no carbon thus burns to form water with no CO₂ or CO emissions.
- One kg of hydrogen contains roughly equivalent energy to one gallon of gasoline.
- Can be stored as compressed hydrogen at 5,000 – 10,000 psi or liquid hydrogen (cooled to -423⁰F).

Hydrogen Uses



- Emerging fuel for transportation fuel cells.
- Used in modified internal combustion engines.
- Fuel cells use a direct electrochemical reaction to produce electricity on board the vehicle. This electricity is used to power electric motors.
- Ongoing demonstration projects in select U.S. areas.

Hydrogen Considerations

- Vehicles not available for commercial sale.
- Infrastructure extremely limited



VIRGINIA CLEAN CITIES

Contact Information



www.hrccc.org

Chelsea Jenkins 757-256-8528 cjenkins@hrccc.org

Al Christopher 804-436-3867 al.christopher@hrccc.org