



California Natural Gas Vehicle Coalition

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Natural Gas Vehicles: A Key Path to 2020 and 2050 GHG Reductions

NGVs provide a pathway to meeting both California's legally mandated near-term greenhouse gas emission cuts and long-term goals. NGVs commercially available today far exceed the Low Carbon Fuel Standard's 2020 requirement. And with demonstrated renewable fuel production, ultraclean fuel blends, and CNG hybrid technology, NGVs can deliver ever-lower emissions while providing an on-ramp for other advanced technologies.

Renewable natural gas is a near-zero carbon fuel

Renewable natural gas is among the lowest-carbon fuels CARB has analyzed. CNG from landfill gas has a carbon intensity of 11.01¹—using it in place of gasoline or diesel cuts carbon emissions about 88.5% or more.

Current, in-use technology² can generate 121 billion cubic feet (bcf) of biomethane per year in California from landfills, wastewater treatment plants, and animal feedlots. That's enough to **replace 29% of the diesel fuel** used for transportation in California in 2007, reducing carbon emissions by 8.05 million metric tons of carbon dioxide equivalent (MMTCO₂e).

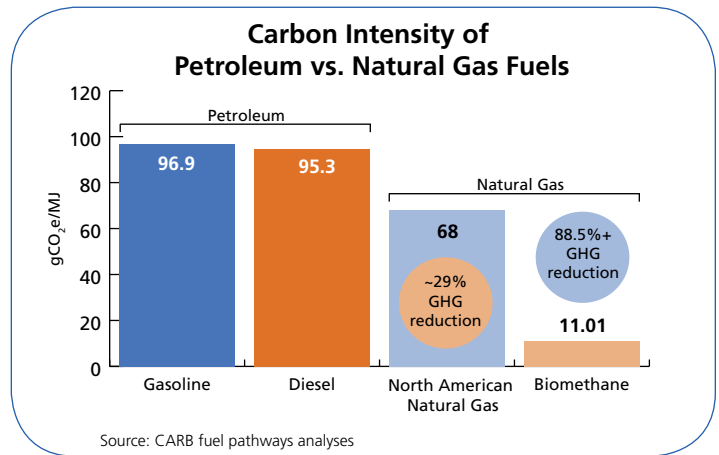
Another 250 bcf of dry biomass—agricultural waste, forest waste, municipal solid waste—could be converted to biosynthetic natural gas (bio-SNG)³ each year. Add that to the biomethane stock, and **renewable natural gas could replace 85% of diesel fuel** used for transportation in California. No vehicle or refueling modifications are required—renewable natural gas is used in NGVs just like conventional natural gas.

Biomethane is most needed in transportation. While biomethane can be used in power generation, using it in transportation will have the greatest impact on the

state's greenhouse gas (GHG) goals. Transportation is the largest single source of GHG emissions in California. Using biomethane in heavy-duty vehicles cuts GHG emissions dramatically (about 85.5%), and should be a key strategy: the heavy-duty sector uses a lot of fuel, and few—if any—near-term options can match this reduction.

Conventional natural gas delivers large GHG reductions

Natural gas more than meets the 2020 Low Carbon Fuel Standard today. The carbon intensity of North American natural gas is nearly **29% lower than diesel fuel and 30% lower than gasoline⁴**—and 98% of our natural gas comes from North America. Even if diesel and gasoline achieve the 10% carbon reduction mandate by 2020, natural gas will remain significantly less carbon intense.



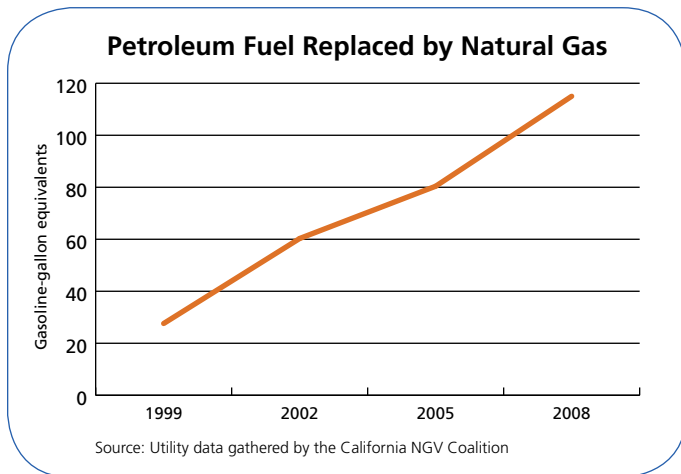
NGVs are California's most successful alternative fuel vehicles

27,000 NGVs are operating in California. NGV use has grown continuously despite many years of limited incentives, inexpensive petroleum fuels, and lack of

strong policies favoring AFVs. Natural gas replaced about 27.6 million gallons of petroleum fuels in California in 1999—and 115 million gallons in 2008⁵.

NGVs are the cleanest vehicles available in most categories. NGV emissions of criteria air pollutants have always been substantially lower than diesel and gasoline vehicle emissions. Heavy-duty natural gas engines met 2010 EPA emissions standards in 2007, making them six times cleaner than 2007 diesel engines in terms of smog-forming hydrocarbon and nitrogen oxide (NOx) emissions. The CNG-powered **Honda Civic GX is the greenest vehicle** on the market, according to the American Council for an Energy-Efficient Economy.

Technology advances are making NGVs even cleaner and more efficient. The San Diego Metropolitan Transit System's prototype CNG-electric hybrid bus improves range and fuel economy 10–20%. Toyota has built a hybrid CNG Camry prototype. And hydrogen-CNG blend fuels reduce emissions significantly: SunLine Transit Agency found that current CNG engines can produce 50% lower NOx emissions with a hydrogen blend of just 20%.



NGVs are affordable today. Typically less expensive, natural gas fuels can result in lifecycle costs that make NGVs more affordable than diesel or gasoline vehicles. A 2005 TIAX study⁶ determined that heavy-duty NGVs have lifecycle costs comparable to diesel vehicles with oil prices as low as \$21 a barrel, and much lower than diesel when oil costs \$60 a barrel (OPEC's minimum target price⁷).

Lifecycle Costs for Natural Gas vs. Diesel Vehicles

	Break-Even Oil Price*	Annual NGV Savings at \$60/Barrel Oil
Refuse trucks	\$21/barrel	\$4,700
Transit buses	\$30/barrel	\$2,900
Short-haul trucks	\$28/barrel	\$5,300

* NGVs and diesel vehicles have the same lifecycle cost with oil at this price

Source: TIAX, Comparative Costs of 2010 Heavy-Duty Diesel and Natural Gas Technologies, June 7, 2005

Infrastructure and vehicles serve core markets and provide a platform for the future

Natural gas vehicles serve more markets than any other alternative. NGVs can replace diesel vehicles in most heavy-duty uses: port drayage, refuse hauling, transit, delivery operations, and more. In most cases, they're the only AFV that can provide a solution in the near- to mid-term.

Small-volume manufacturers make a range of light-duty vehicles for fleets. And while Honda is the only OEM that currently sells a passenger car to U.S. retail customers (the Civic GX), other OEMs could: **there are 8.6 million NGVs in use worldwide.** At least 20 manufacturers worldwide make NGVs; GM alone makes 9 models. New, long-term policies favoring low-carbon fuels—like AB 118 and AB 32—make California a more attractive market for these vehicles.

The natural gas fueling infrastructure is the most extensive of any alternative in the state: more than 460 stations serve NGVs, with over one-third providing public access. Commuters can also fill up conveniently and cheaply at home using the Phill refueling appliance.

These vehicles and stations provide a platform for technological advances that will help achieve 2050 GHG reduction goals. The network of natural gas fueling stations can be upgraded to supply hydrogen. And use of hydrogen-CNG blends not only reduces emissions significantly, it also creates early demand for hydrogen fueling infrastructure.

1 CARB, Detailed California-Modified GREET Pathway for Compressed Natural Gas (CNG) from Landfill Gas, October 8, 2008

2 CEC, A Roadmap for the Development of Biomass in California—Draft Collaborative Report, November 2006 and University of San Diego Energy Policy Initiative Center, Biogas Production and Uses on California Dairy Farms, August 2007

3 CEC, A Roadmap for the Development of Biomass in California—Draft Collaborative Report, November 2006

4 CARB, Detailed California-Modified GREET Pathway for Compressed Natural Gas (CNG) from North American Natural Gas, January 12, 2009

5 Data from California natural gas utilities

6 TIAX, Comparative Costs of 2010 Heavy-Duty Diesel and Natural Gas Technologies, June 7, 2005

7 <http://news.bbc.co.uk/2/hi/business/davos/7857791.stm>