

TAKING AN ALTERNATIVE ROUTE

**ALTERNATIVE
FUEL**

**GLOSSARY
OF TERMS**

ALTERNATIVE FUEL INFORMATION
U.S. DEPARTMENT OF ENERGY

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ALTERNATIVE FUELS GLOSSARY OF TERMS

Acronyms Quick List

AFDC	Alternative Fuels Data Center
AFUP	Alternative Fuels Utilization Program
AFV	alternative-fuel vehicle
AMFA	Alternative Motor Fuels Act of 1988
AQMD	Air Quality Management District
ASTM	American Society for Testing & Materials
Btu	British thermal unit
BTX	benzene, toluene, xylene
CAA	Clean Air Act
CAAA	Clean Air Act Amendments of 1990
CAFE	corporate average fuel economy
CARB	California Air Resources Board
CFFP	Clean Fuel Fleet Program
CFV	clean-fuel vehicle
CMSA	Consolidated Metropolitan Statistical Area
CNG	compressed natural gas
CO	carbon monoxide
CO ₂	carbon dioxide
CPP	California Pilot Program
CRADA	Cooperative Research and Development Agreement
CRC	Coordinating Research Council
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
EPACT	Energy Policy Act of 1992
ETBE	ethyl tertiary butyl ether
FIP	Federal Implementation Plan
FFV	flexible-fuel vehicle
GVWR	gross vehicle weight rated
HC	hydrocarbon
ILEV	inherently low-emission vehicle
LEV	low-emission vehicle
LNG	liquefied natural gas
LPG	liquefied petroleum gas (propane)
MSW	municipal solid waste
MTBE	methyl tertiary butyl ether
NAAQS	National Ambient Air Quality Standards
NGV	Natural Gas Vehicle
NMOG	Non-Methane Organic
NO	nitric oxide
NO ₂	nitrogen dioxide
NO _x	oxides of nitrogen
OEM	Original Equipment Manufacturer
ORVR	onboard refueling vapor recovery
PM	particulate matter
PSI	pounds per square inch

RAF	Reactivity Adjustment Factor
RHC	reactive hydrocarbons
RVP	Reid Vapor Pressure
SIP	State Implementation Plan
SO ₂	sulfur dioxide
SO _x	oxides of sulfur
SULEV	Super Ultra-Low-Emission Vehicle
TAEF	tertiary amyl ethyl ether
TAME	tertiary amyl methyl ether
TCM	transportation control measure
THC	total hydrocarbons
TLEV	transitional low-emission vehicle
ULEV	ultra-low-emission vehicle
VFV	variable-fuel vehicle
VOC	volatile organic compound
ZEV	zero-emission vehicle

Additives: Chemicals added to fuel in very small quantities to improve and maintain fuel quality. Detergents and corrosion inhibitors are examples of gasoline additives.

Air Quality Management District (AQMD): A term used principally in California to describe administrative districts organized to control air pollution. Nationwide, AQMDs are parallel to the areas designated for classification against the National Ambient Air Quality Standards (NAAQS). Generally, AQMDs and their national parallel encompass multiple jurisdictions and closely follow the definition of Consolidated Metropolitan Statistical Areas and Metropolitan Statistical Areas.

Air Toxics: Toxic air pollutants defined under Title II of the CAA, including benzene, formaldehyde, acetaldehyde, 1-3 butadiene and polycyclic organic matter (POM). Benzene is a constituent of motor vehicle exhaust, evaporative and refueling emissions. The other compounds are exhaust pollutants.

Alcohols: Organic compounds that are distinguished from hydrocarbons by the inclusion of a hydroxyl group. The two simplest alcohols are methanol and ethanol.

Aldehydes: A class of organic compounds derived by removing the hydrogen atoms from an alcohol. Aldehydes can be produced from the oxidation of an alcohol.

Alternative Fuel: As defined pursuant to the EPACT, methanol, denatured ethanol and other alcohols, separately or in mixtures of 85% by volume or more with gasoline or other fuels, CNG, LNG, LPG, hydrogen, "coal-derived liquid fuels," fuels "other than alcohols" derived from "biological materials," electricity, neat biodiesel, or any other fuel determined to be "substantially not petroleum" and yielding "substantial energy security benefits and substantial environmental benefits."

Alternative-Fuel Provider: A fuel provider (or any affiliate or business unit under its control) is an alternative-fuel provider if its principal business is producing, storing, refining, processing, transporting, distributing, importing or selling (at wholesale or retail) any alternative fuel (other than electricity); or generating, transmitting, importing, or selling (at wholesale and retail) electricity; or if that fuel provider produces, imports, or produces and imports (in combination), an average of 50,000 barrels per day of petroleum and 30% (a substantial portion) or more of its gross annual revenues are derived from producing alternative fuels.

Alternative-Fuel Vehicle (AFV): As defined by the Energy Policy Act, any dedicated, flexible-fueled, or dual-fueled vehicle designed to operate on at least one alternative fuel.

Alternative Fuels Data Center (AFDC): A program sponsored by DOE to collect emissions, operational and maintenance data on all types of AFVs across the country.

Alternative Fuels Utilization Program (AFUP): A program managed by DOE with the goals of improving national energy security by displacing imported oil, improving air quality by development and widespread use of alternative fuels for transportation and increasing the production of AFVs.

Alternative Motor Fuels Act of 1988 (AMFA): Public Law 100-494. Encourages the development, production and demonstration of alternative motor fuels and AFVs.

American Society for Testing and Materials (ASTM): A non-profit organization that provides a management system to develop published technical information. ASTM standards, test methods, specifications and procedures are recognized as definitive guidelines for motor fuel quality as well as a broad range of other products and procedures.

Anhydrous: Describes a compound that does not contain any water. Ethanol produced for fuel use is often referred to as anhydrous ethanol, as it has had almost all water removed.

Aromatics: Hydrocarbons based on the ringed six-carbon benzene series or related organic groups. Benzene, toluene and xylene are the principal aromatics, commonly referred to as the BTX group. They represent one of the heaviest fractions in gasoline.

Balance of Payments: The dollar amount difference between a country's exports and imports. In the United States, large oil imports are one of the main causes of the negative balance of payments with the rest of the world.

Benzene: A six-carbon aromatic; common gasoline component identified as being toxic. Benzene is a known carcinogen.

Bi-fuel Vehicle: A vehicle with two separate fuel systems designed to run on either an alternative fuel, or gasoline or diesel, using only one fuel at a time. Bi-fuel vehicles are referred to as "dual-fuel" vehicles in the CAA and EPACT.

Biochemical Conversion: The use of enzymes and catalysts to change biological substances chemically to produce energy products. For example, the digestion of organic wastes or sewage by microorganisms to produce methane is a biochemical process.

Biodiesel: A biodegradable transportation fuel for use in diesel engines that is produced through transesterification of organically derived oils or fats. Biodiesel is used as a component of diesel fuel. In the future it may be used as a replacement for diesel.

Biomass: Renewable organic matter such as agricultural crops, crop-waste residues, wood, animal and municipal wastes, aquatic plants; fungal growth, etc., used for the production of energy.

British Thermal Unit (Btu): A standard unit for measuring heat energy. One Btu represents the amount of heat required to raise one pound of water one degree Fahrenheit (at sea level).

Butane: A gas, easily liquefied, recovered from natural gas. Used as a low-volatility component of motor gasoline, processed further for a high-octane gasoline component, used in LPG for domestic and industrial applications and used as a raw material for petrochemical synthesis.

Butyl Alcohol: Alcohol derived from butane that is used in organic synthesis and as a solvent.

BTX: Industry term referring to the group of aromatic hydrocarbons benzene, toluene and xylene (see aromatics).

California Air Resources Board (CARB): The state agency that regulates the air quality in California. Air quality regulations established by CARB are often stricter than those set by the federal government.

California Low-Emission Vehicle Program: State requirement for automakers to produce vehicles with fewer emissions than current EPA standards. The five categories of California Low-Emission Vehicle Program standards from least to most stringent are TLEV, LEV, ULEV, SULEV and ZEV. (See Appendix A for a listing of CARB's tailpipe emissions standards.)

California Pilot Program: Federal program, administered by EPA under the Clean Air Act, which sets lower emission standards (relative to cars in the general U.S. market) for a set number of new passenger cars and light trucks sold in California. Beginning in 1996, the program will require the sale of 150,000 clean vehicles in the state, increasing in 1999 to 300,000 annually. California must mandate availability of any fuel necessary to operate clean fuel vehicles.

Carbon Dioxide (CO₂): A product of combustion that has become an environmental concern in recent years. CO₂ does not directly impair human health but is a "greenhouse gas" that traps the earth's heat and contributes to the potential for global warming.

Carbon Monoxide (CO): A colorless, odorless gas produced by the incomplete combustion of fuels with a limited oxygen supply, as in automobile engines. CO is poisonous if inhaled, entering the bloodstream through the lungs and forming carboxyhemoglobin, a compound that inhibits the blood's capacity to carry oxygen to organs and tissues. CO can impair exercise capacity, visual perception, manual dexterity and learning functions.

Carbon Sequestration: The absorption and storage of CO₂ from the atmosphere by the roots and leaves of plants; the carbon builds up as organic matter in the soil.

Carcinogens: Chemicals and other substances known to cause cancer.

Catalyst: A substance whose presence changes the rate of chemical reaction without itself undergoing permanent change in its composition. Catalysts may be accelerators or retarders. Most inorganic catalysts are powdered metals and metal oxides, chiefly used in the petroleum, vehicle and heavy chemical industries.

Certification of Higher-learning in Alternative Motorfuels Program (CHAMP): A national program established by DOE to implement Section 411 of the Energy Policy Act of 1992.

Cetane: Ignition performance rating of diesel fuel. Diesel equivalent to gasoline octane.

Clean Air Act (CAA): The original Clean Air Act was signed in 1963. The law set emissions standards for stationary sources (e.g., factories, power plants). The CAA was amended several times, most recently in 1990 (P.L. 101-549). The Amendments of 1970 introduced motor vehicle emission standards (e.g., automobiles, trucks). Criteria pollutants included lead, ozone, CO, SO₂, NO_x and PM, as well as air toxics. In 1990, reformulated gasoline (RFG) and oxygenated gasoline provisions were added. The RFG provision requires use of RFG *all year* in certain areas. The oxygenated gasoline provision requires the use of oxygenated gasoline during *certain months*, when CO and ozone pollution are most serious. The regulations also require certain fleet operators to use clean-fuel vehicles in 22 cities.

Clean Diesel: An evolving definition of diesel fuel with lower emission specifications, which strictly limit sulfur content to 0.05 weight %; in California, aromatics content is further limited to 10 volume % (for large refiners).

Clean Fuel: CAA (as amended in 1990) specification that identifies RFG and alternative fuels as clean fuel.

Clean-Fuel Fleet Program: Federal program requiring fleet purchase of Clean-Fuel Vehicles beginning in 1988.

Clean Fuel Vehicle (CFV): Any vehicle certified by EPA as meeting certain federal emissions standards. The three categories of federal CFV standards from least to most stringent are LEV, ULEV, and ZEV. The ILEV standard is voluntary and does not need to be adopted by states as part of the Clean-Fuel Fleet Program. CFVs are eligible for two federal programs, the California Pilot Program and the Clean-Fuel Fleet Program. CFV exhaust emissions standards for light-duty vehicles and light-duty trucks are numerically similar to those of CARB's California Low-Emission Vehicle Program. (See Appendix A for a listing of CARB's tailpipe emissions standards for passenger cars and light-duty trucks 0-3750 LVW.)

Closed-Loop Carburetion: System in which the fuel/air ratio in the engine is carefully controlled to optimize emissions performance. A closed-loop system uses a fuel metering correction signal to optimize fuel metering.

Compression Ignition: The form of ignition that initiates combustion in a diesel engine. The rapid compression of air within the cylinders generates the heat required to ignite the fuel as it is injected.

Compressed Natural Gas (CNG): Natural gas that has been compressed under high pressures, typically between 2000 and 3600 psi, held in a container. The gas expands when released for use as a fuel.

Congestion Mitigation and Air Quality Improvement (CMAQ) Program: A federal grant program established by the Intermodal Surface Transportation Act of 1991 that allocates funds to states to help them simultaneously expand or initiate transportation services while improving air quality. CMAQ funds may be used to support alternative-fuel and alternative-fuel vehicle programs.

Consolidated Metropolitan Statistical Area (CMSA): As used in the Clean Air Act (CAA) and the Energy Policy Act (EPACT), geographical areas defined by the Bureau of Census that includes cities or combinations of multiple cities with large population concentrations. The Metropolitan Statistical Area (MSA) refers to geographical areas that generally include one city with a smaller population concentration. For certain programs (e.g., oxygenated gasoline), the CAA adds definitions employed by the Office of Management and Budget. For all EPACT mandates for AFVs and for the CAA Clean-Fuel Vehicle Program, use of the terms CMSA and MSA are delimited to areas with a 1980 population of 250,000 or more, as determined by the Bureau of the Census.

Converted or Conversion Vehicle: A vehicle originally designed to operate on gasoline or diesel that has been modified or altered to run on an alternative fuel.

Cooperative Research and Development Agreement (CRADA):

Federal and private joint research and development program that is used to further technology commercialization.

Corporate Average Fuel Economy (CAFE): (P.L. 94-163) Law passed in 1975 that set federal fuel economy standards. The CAFE values are an average of city and highway fuel economy test results weighted by a manufacturer for either its car or truck fleet.

Corrosion Inhibitors: Additives used to inhibit corrosion in the fuel system (e.g., rust).

Co-solvents: Heavier molecular weight alcohols used with methanol to improve water tolerance and reduce other negative characteristics of gasoline/alcohol blends. Tertiary butyl alcohol (TBA) was used commercially as a co-solvent for methanol/gasoline blends during the 1980s.

Cryogenic Storage: Extreme low-temperature storage.

Dedicated Vehicle: Operates solely on one fuel. Generally, dedicated vehicles provide superior emissions and performance results because their design has been optimized for operation on only one fuel.

Denatured Alcohol: Ethanol that contains a small amount of a toxic substance, such as methanol or gasoline, which cannot be removed easily by chemical or physical means. Alcohols intended for industrial use must be denatured to avoid federal alcoholic beverage tax.

Department of Energy: See U.S. Department of Energy (DOE).

Detergent: Additives used to inhibit deposit formation in the fuel and intake systems in automobiles.

Distillation Curve: The percentages of gasoline that evaporate at various temperatures. The distillation curve is an important indicator for fuel standards such as volatility (vaporization).

Domestic Fuel: As defined by the Energy Policy Act, Section 301, domestic fuel is derived from resources within the United States, its possessions and commonwealths, and Canada and Mexico (the two nations in a free-trade agreement with the U.S.).

Dual-Fuel Vehicle:

- **EPACT Definition:** Vehicle designed to operate on a combination of an alternative fuel and a conventional fuel. This includes:
 - a) vehicles using a mixture of gasoline or diesel and an alternative fuel in one fuel tank, commonly called flexible-fueled vehicles;
 - and b) vehicles capable of operating either on an alternative fuel, a conventional fuel or both, simultaneously using two fuel systems commonly called bi-fuel vehicles.
- **CAA Definition:** Vehicle with two separate fuel systems designed to run on either an alternative fuel or conventional gasoline, using only one fuel at a time.

E10 (Gasohol): Ethanol/gasoline mixture containing 10% denatured ethanol and 90% gasoline, by volume.

E85: Ethanol/gasoline mixture containing 85% denatured ethanol and 15% gasoline, by volume.

E93: Ethanol mixture containing 93% ethanol, 5% methanol and 2% kerosene, by volume.

E95: Ethanol/gasoline mixture containing 95% denatured ethanol and 5% gasoline, by volume.

Electricity: Electric current used as a power source. Electricity can be generated from a variety of feedstocks including oil, coal, nuclear, hydro, natural gas, wind, and solar. In electric vehicles, onboard rechargeable batteries power an electric motor.

Electric Vehicle: A vehicle powered by electricity, generally provided by storage batteries but also provided by photovoltaic cells or a fuel cell.

Energy Policy Act of 1992 (EPACT): (P.L. 102-486) A broad-ranging act signed into law on Oct. 24, 1992. Titles III, IV, V, XV and XIX of EPACT deal with alternative transportation fuels. EPACT accelerates the purchase requirements for AFVs by the federal fleet, proposes eliminating the cap on CAFE credits that manufacturers can earn by producing dual- and flexible-fuel vehicles and requires fleets in large urban areas to purchase AFVs. Establishes tax incentives for purchasing AFVs, converting conventional gasoline vehicles to operate on alternative fuels and installing refueling or recharging facilities by the private sector.

Environmental Protection Agency: See **U.S. Environmental Protection Agency (EPA)**

Ester: An organic compound formed by reacting an acid with an alcohol, always resulting in the elimination of water.

Ethanol (also known as Ethyl Alcohol, Grain Alcohol, $\text{CH}_3\text{CH}_2\text{OH}$): Can be produced chemically from ethylene or biologically from the fermentation of various sugars from carbohydrates found in agricultural crops and cellulosic residues from crops or wood. Used in the United States as a gasoline octane enhancer and oxygenate, it increases octane 2.5 to 3.0 numbers at 10% concentration. Ethanol also can be used in higher concentration in alternative-fuel vehicles optimized for its use.

Ether: A class of organic compounds containing an oxygen atom linked to two organic groups.

Etherification: Oxygenation of an olefin by methanol or ethanol. For example, MTBE is formed from the chemical reaction of isobutylene and methanol.

Ethyl Alcohol: See **Ethanol**.

Ethyl Ester: A fatty ester formed when organically derived oils are combined with ethanol in the presence of a catalyst. After water washing, vacuum drying and filtration, the resulting ethyl ester has characteristics similar to petroleum-based diesel motor fuels.

Ethyl Tertiary Butyl Ether (ETBE): An aliphatic ether similar to MTBE. This fuel oxygenate is manufactured by reacting isobutylene with ethanol. Having high octane and low volatility characteristics, ETBE can be added to gasoline up to a level of approximately 17% by volume. ETBE is not yet commercially available.

Evaporative Emissions: Hydrocarbon vapors that escape from a fuel storage tank or a vehicle fuel tank or vehicle fuel system.

Executive Orders 12759 and 12844: Two Presidential orders which establish requirements for federal agencies to purchase AFVs. Order 12844 accelerates agency acquisitions by 50% beyond requirements contained in Section 303 of the Energy Policy Act for fiscal years 1993-1995, subject to the availability of funds.

Feedstock: Any material converted to another form of fuel or energy product. For example, corn starch can be used as a feedstock for ethanol production.

Fermentation: The enzymatic transformation by microorganisms of organic compounds such as sugars. It is usually accompanied by the evolution of gas, as in the fermentation of glucose into ethanol and CO₂.

Flexible-Fuel Vehicles (FFV): Vehicles with a common fuel tank designed to run on varying blends of unleaded gasoline with either ethanol or methanol.

Fuel Cell: An electrochemical engine (no moving parts) that converts the chemical energy of a fuel, such as hydrogen, and an oxidant, such as oxygen, directly to electricity. The principal components of a fuel cell are catalytically activated electrodes for the fuel (anode) and the oxidant (cathode) and an electrolyte to conduct ions between the two electrodes.

Fungible: A term used within the oil refining industry to denote products that are suitable for transmission by pipeline.

Gasification: Any chemical or heat process used to convert a feedstock to a gaseous fuel.

Gasohol: In the United States, gasohol refers to gasoline that contains 10% ethanol by volume. This term was used in the late 1970s and early 1980s but has been largely replaced by terms such as E10, Super Unleaded Plus Ethanol or Unleaded Plus Ethanol.

Global Warming: The theoretical escalation of global temperatures caused by the increase of greenhouse gas emissions in the lower atmosphere.

Greenhouse Effect: A warming of the earth and its atmosphere as a result of the thermal trapping of incoming solar radiation by CO₂, water vapor, methane, nitrous oxide, chlorofluorocarbons and other gases, both natural and man-made.

Hybrid-Electric Vehicle (HEV): A vehicle that is powered by two or more energy sources, one of which is electricity. HEVs may combine the engine and fuel system of a conventional vehicle with the batteries and electric motor of an electric vehicle in a single drivetrain.

Inherently Low-Emission Vehicle (ILEV): FEDERAL ONLY. Describes vehicle meeting EPA's CFV ILEV standards. Tailpipe standards may be HC LEV with ULEV NO_x, ULEV, or ZEV and includes the additional requirement that evaporative emissions be 2 grams per test over the full test procedure and 5 grams per test without the use of any auxiliary emission control devices. ILEVs will be dedicated AFVs in most cases. Dual-fuel vehicles will be considered ILEVs only if both fuels meet the standard. (Very low-volatility gasoline may also meet the standard.) ILEVs are exempt from certain transportation control measures, including high-occupancy vehicle (HOV) lane restrictions. This standard is voluntary and need not be adopted by states.

Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA):

An omnibus act that further integrates the national intermodal surface transportation system and authorizes funds for highway construction, highway safety programs, and mass transit programs. ISTEA seeks a national intermodal surface transportation system that is economical, energy efficient, and environmentally sound. Section 1008 of the ISTEA establishes the Congestion Mitigation and Air Quality Improvement Program which can provide funds to support alternative-fuel and alternative-fuel vehicle programs.

Lead: see **Tetraethyl Lead**.

Liquefied Natural Gas (LNG): Natural gas that has been condensed to a liquid typically by cryogenically cooling the gas.

Liquefied Petroleum Gas (LPG): A mixture of hydrocarbons found in natural gas and produced from crude oil, used principally as a feedstock for the chemical industry, home heating fuel, and motor vehicle fuel. Also known as the principal constituent of propane.

Low-Emission Vehicle (LEV): Describes vehicle meeting either EPA's CFV LEV standards or CARB's California Low Emission Vehicle Program LEV standards. LEVs produce fewer emissions than TLEVs.

Lubricity: Capacity to reduce friction.

M85: 85% methanol and 15% unleaded gasoline by volume, used as a motor fuel in FFVs.

M100: 100% (neat) methanol.

Methane (CH₄): The simplest of the hydrocarbons and the principal constituent of natural gas. Pure methane has a heating value of 1,012 Btu per standard cubic foot.

Methanol (also known as Methyl Alcohol, Wood Alcohol, CH₃OH): A liquid fuel formed by catalytically combining CO with hydrogen in a 1:2 ratio under high temperature and pressure. Commercially, it is typically manufactured by steam reforming natural gas. Also formed in the destructive distillation of wood.

Methyl Alcohol: See **Methanol**.

Methyl Ester: A fatty ester formed when organically derived oils are combined with methanol in the presence of a catalyst. Methyl ester has characteristics similar to petroleum-based diesel motor fuels.

Methyl Tertiary Butyl Ether (MTBE): An ether manufactured by reacting methanol and isobutylene. The resulting ether has high octane and low volatility. MTBE is a fuel oxygenate and is permitted in unleaded gasoline up to a level of 15% by volume.

National Ambient Air Quality Standards (NAAQS): Ambient standards for criteria air pollutants specifically regulated under the CAA. These pollutants include ozone, CO, NO₂, lead, particulate matter and SO_x.

National Automotive Technical Education Foundation: A consortium of automotive education experts which has established a steering committee to administer the CHAMP certification process at educational institutions.

National Low-Emission Vehicle (NLEV) Program: Still under development, this program creates voluntary requirements which automakers can adopt in lieu of compliance with other vehicle emission control measures. The program applies to the manufacture of new light-duty vehicles and new light-duty trucks up to 6,000 lb GVWR. Vehicle exhaust emission standards have been established for the 13 northeastern states of the Ozone Transport Commission, applicable on and after the 1997 model year. Standards are extended to the rest of the U.S., except California, on and after the 2001 model year. In general, the standards lie between levels established for the federal Tier I Program and the California LEV Program. Automakers can use a manufacturer's effective average standard to meet the non-methane organic gas standard. Vehicles are certified with California test procedures.

Natural Gas: A mixture of gaseous hydrocarbons, primarily methane, occurring naturally in the earth and used principally as a fuel.

Near Neat Fuel: Fuel that is virtually free from admixture or dilution.

Neat Fuel: Fuel that is free from admixture or dilution with other fuels.

Neat Alcohol Fuel: Straight or 100% alcohol (not blended with gasoline), usually in the form of either ethanol or methanol.

Nonattainment Area: A region, determined by population density in accordance with the U.S. Census Bureau, which exceeds minimum acceptable NAAQS for one or more "criteria pollutants" (see **Clean Air Act and NAAQS**). Such areas are required to seek modifications to their SIPs, setting forth a reasonable timetable using EPA-approved means to achieve attainment of NAAQS for these criteria pollutants by a certain date. Under the CAA, if a nonattainment area fails to attain NAAQS, EPA may superimpose a FIP with stricter requirements or impose fines, construction bans, cutoffs in federal grant revenues, etc., until the area achieves the applicable NAAQS.

Non-Methane Organic Gases (NMOG): The sum of non-oxygenated and oxygenated hydrocarbons exclusive of methane contained in a gas sample as measured in accordance with California's non-methane organic gas test procedure.

Octane Enhancer: Any substance such as MTBE, ETBE, toluene and xylene that is added to gasoline to increase octane and reduce engine knock.

Octane Rating (Octane Number): A measure of a fuel's resistance to self ignition, hence a measure as well of the antiknock properties of the fuel.

- **Pump Octane:** The octane as posted on retail gasoline dispensers as $(R+M)/2$; same as Antiknock Index.
- **Motor Octane:** The octane as tested in a single-cylinder octane test engine at more severe operating conditions. Motor Octane Number (MON) affects high-speed and part-throttle knock and performance under load, passing, climbing and other operating conditions. Motor octane is represented by the designation M in the $(R+M)/2$ equation and is the lower of the two numbers.

- **Research Octane Number (RON):** The octane as tested in a single-cylinder octane test engine operated under less severe operating conditions. RON affects low- to medium-speed knock and engine run-on. Research Octane is presented by the designation R in the $(R+M)/2$ equation and is the higher of the two numbers.

OEM: Original Equipment Manufacturer.

Office of Mobile Sources: Division of EPA that proposes, promulgates and enforces regulations to control emissions of NAAQS pollutants and precursors from motor fuels and vehicles.

Onboard Refueling Vapor Recovery (ORVR): System required on vehicles beginning in 1998 to control refueling emissions.

Open-Loop Fuel Control: System in which the air/fuel mixture is preset by design with no feedback correction signal to optimize fuel metering.

Oxides of Nitrogen (NO_x): Regulated air pollutants, primarily NO and NO₂ but including other substances in minute concentrations. Under the high pressure and temperature conditions in an engine, nitrogen and oxygen atoms in the air react to form various NO_x. Like hydrocarbons, NO_x are precursors to the formation of smog. They also contribute to the formation of acid rain.

Oxygenate: A term used in the petroleum industry to denote fuel additives containing hydrogen, carbon and oxygen in their molecular structure. Includes ethers such as MTBE and ETBE and alcohols such as ethanol and methanol.

Oxygenated Gasoline: Gasoline containing an oxygenate such as ethanol or MTBE. The increased oxygen content promotes more complete combustion, thereby reducing tailpipe emissions of CO.

Ozone: Tropospheric ozone (smog) is formed when volatile organic compounds (VOCs), oxygen and NO_x react in the presence of sunlight (not to be confused with stratospheric ozone, which is found in the upper atmosphere and protects the earth from the sun's ultraviolet rays). Though beneficial in the upper atmosphere, at ground level, ozone is a respiratory irritant and considered a pollutant.

Paraffins: Group of saturated aliphatic hydrocarbons, including methane, ethane, propane and butane and noted by the suffix "-ane".

Particulate Matter (PM): A generic term for a broad class of chemically and physically diverse substances that exist as discrete particles (liquid droplets or solids) over a wide range of sizes. A NAAQS pollutant.

Particulate Trap: Diesel vehicle emission control device that traps and incinerates diesel particulate emissions after they are exhausted from the engine but before they are expelled into the atmosphere.

Petroleum Fuel: Gasoline and diesel fuel.

Phase Separation: The phenomenon of a separation of a liquid or vapor into two or more physically distinct and mechanically separable portions or layers.

Propane: See **Liquefied Petroleum Gas (LPG)**.

Reactivity Adjustment Factor (RAF): An NMOG adjustment used in the certification of vehicles to the California emission standards to reflect reduced ozone forming potential of a fuel, especially alternative fuels.

Reformulated Gasoline (RFG): Gasolines that have had their compositions and/or characteristics altered to reduce vehicular emissions of pollutants, particularly pursuant to EPA regulations under the CAA.

Refueling Emissions: VOC vapors that escape from the vehicle fuel tank during refueling. Storage II pump controls and onboard refueling vapor recovery systems (ORVR) are intended to control these emissions.

Reid Vapor Pressure (RVP): A standard measurement of a liquid's vapor pressure in psi at 100 degrees Fahrenheit. It is an indication of the propensity of the liquid to evaporate.

Smog: A visible haze caused primarily by particulate matter and ozone.

Spark Ignition Engine: Internal combustion engine in which the charge is ignited electrically (e.g., with a spark plug).

State Implementation Plan (SIP): Plan that a state must submit to EPA under the CAA to demonstrate compliance to NAAQS.

Super Ultra-Low-Emission Vehicle (SULEV): Describes California medium-duty vehicle that produces fewer emissions than an ULEV. There is no federal equivalent and therefore qualifies as a ULEV under CFF.

Tax Incentives: In general, a means of employing the tax code to stimulate investment in or development of a socially desirable economic objective without direct expenditure from the budget of a given unit of government. Such incentives can take the form of tax exemptions or credits.

Tetraethyl Lead or Lead: An octane enhancer. One gram of lead increases the octane of one gallon of gasoline about 6 numbers. The EPA has phased down the use of lead in gasoline as it has been determined to be a health hazard. Lead has been prohibited in highway vehicle gasoline since January 1, 1996.

Tertiary Amyl Ethyl Ether (TAEE): An ether based on reactive C₅ olefins and ethanol.

Tertiary Amyl Methyl Ether (TAME): An ether based on reactive C₅ olefins and methanol.

Toluene: Basic aromatic compound derived from petroleum and used to increase octane. The most common hydrocarbon purchased for use in increasing octane.

Toxic Emission: Any pollutant emitted from a source that can negatively affect human health or the environment.

Transesterification: A process in which organically-derived oils or fats are combined with alcohol (ethanol or methanol) in the presence of a catalyst to form esters (ethyl or methyl ester).

Transitional Low-Emission Vehicle (TLEV): Describes vehicle meeting either EPA's CFV TLEV standards or CARB's California Low-Emission Vehicle Program TLEV standards. TLEVs produce fewer emissions than federal Tier 1 vehicles. TLEVs are eligible for the federal California Pilot Program but not eligible for the Clean-Fuel Fleet Program.

Transportation Control Measures (TCM): Restrictions imposed by state or local governments to limit use or access by vehicles during certain times or subject to specific operating requirements, e.g., high-occupancy vehicle (HOV) lanes.

Ultra-Low-Emission Vehicle (ULEV): Describes vehicle meeting either EPA's CFV ULEV standards or CARB's California Low-Emission Vehicle Program ULEV standards. ULEVs produce fewer emissions than LEVs. Fleets who purchase CFV ULEVs may earn credits under the Clean-Fuel Fleet Vehicle Program. Manufacturers that sell CFV ULEVs may earn credits under the federal California Pilot Program.

U.S. Department of Energy (DOE): A department of the federal government, established by the Carter Administration in 1977, to consolidate energy-oriented programs and agencies. The DOE mission includes the coordination and management of energy conservation, supply, information dissemination, regulation, research, development and demonstration. The Department includes the Office of Transportation Technologies, the umbrella of the Office of Alternative Fuels.

U.S. Environmental Protection Agency (EPA): A government agency, established by the Nixon Administration in 1970, responsible for the protection of the environment and public health. EPA seeks to reduce air, water and land pollution and pollution from solid waste, radiation, pesticides and toxic substances. EPA also controls emissions from motor vehicles, fuels and fuel additives.

Volatile Organic Compound (VOC): Reactive gases released during combustion or evaporation of fuel and regulated by EPA. VOCs react with NO_x in the presence of sunlight and form ozone.

Vapor Pressure or Volatility: The tendency of a liquid to pass into the vapor state at a given temperature. With automotive fuels, volatility is determined by measuring RVP.

Wood Alcohol: See **Methanol**.

Xylene: An aromatic hydrocarbon derived from petroleum and used to increase octane. Highly valued as a petrochemical feedstock. Xylene is highly photochemically reactive and, as a constituent of tailpipe emissions, is a contributor to smog formation.

Zero-Emission Vehicle (ZEV): Describes vehicle meeting either EPA's CFV ZEV standards or CARB's California Low-Emission Vehicle Program ZEV standards. ZEV standards, usually met with electric vehicles, require zero vehicle (not power plant source) emissions. ZEVs earn more Clean-Fuel Fleet Vehicle Program credits than ULEVs. ZEVs may also meet ILEV standards.

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APPENDIX A

California Vehicle Tailpipe Emission Standards for Passenger Cars and Light-Duty Trucks 0-3750 LWV

(Numerically¹ identical to federal CFV exhaust emission standards)

Low-Emission Vehicle Standards (mileage @ 50,000 or below)			
EMISSIONS	NMOG (g/mi)	CO (g/mi)	NO_x (g/mi)
TLEV	0.125 gpm	3.4 gpm	0.4 gpm
LEV	0.075	3.4	0.2
ULEV	0.040	1.7	0.2
ZEV	zero	zero	zero
Low-Emission Vehicle Standards (mileage between 50,000-100,000)			
TLEV	0.156	4.2	0.6
LEV	0.090	4.2	0.3
ULEV	0.055	2.1	0.3
ZEV	zero	zero	zero

Gasoline Standards: Flexible- and Dual-Fuel Low-Emissions Vehicles (mileage @50,000 or below)			
TLEV	0.250	3.4	0.4
LEV	0.125	3.4	0.2
ULEV	0.075	1.7	0.2
Gasoline Standards: Flexible- and Dual-Fuel Low-Emissions Vehicles (mileage between 50,000-100,000)			
TLEV	0.310	4.2	0.63
LEV	0.156	4.2	0.3
ULEV	0.090	2.1	0.3

¹New California MDV standards do not match federal CFFP standards.

Note: Standards found in section 243(d) of the Clean Air Act. These are the emission standards that are to be met at the time of certification by the manufacturer, including Reactivity Adjustment Factor; NOT estimates of actual in-use emissions over the life of the vehicle. For information on the relative in-use emission impacts of these vehicles, please contact the Vehicle Program and Compliance Division of the Environmental Protection Agency at 313-668-4458 and request "lifetime emissions factors."

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