The National Conference of State Legislatures is the bipartisan organization that serves the legislators and staffs of the states, commonwealths and territories.

NCSL provides research, technical assistance and opportunities for policymakers to exchange ideas on the most pressing state issues and is an effective and respected advocate for the interests of the states in the American federal system. Its objectives are:

- To improve the quality and effectiveness of state legislatures.
- To promote policy innovation and communication among state legislatures.
- To ensure state legislatures a strong, cohesive voice in the federal system.

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EXECUTIVE SUMMARY

Affordable transportation of people and goods is vital to the nation’s economic health. When the price of oil rises, the United States suffers as costs for transportation, food and other goods increase. Because 95 percent of the country’s transportation is powered by oil, few options are available when prices jump, causing the nation’s welfare to be dependent upon the whims of the global oil market. Supply disruptions—or even the threat of disruption—in the Middle East or elsewhere can cause price shifts that cost consumers and industries billions of dollars. In contrast, costs in the nation’s other major energy sector, electricity, are far more stable and predictable. The diverse portfolio of resources used for electric generation dilutes the effect when specific fuel costs rise. In addition, utilities can shift to other, less costly fuels for electricity generation to keep electricity costs lower.

Although the problems caused by lack of fuel diversity in transportation have been recognized for decades, recent spikes in oil prices have encouraged policymakers, innovative industries and consumers to raise U.S. production of transportation energy resources.

Increasing domestic production of oil, for example, has helped the United States decrease imports. Domestically produced oil has many benefits: it reduces the outflows of wealth to potentially unfriendly nations, increases energy security, lowers the trade deficit and promotes economic development. Higher production is not a panacea for volatile oil prices and the damage they inflict on the economy, however; whether oil is produced in the United States, Canada or Saudi Arabia, the price at the pump depends primarily upon international market fluctuations.

Efficiency mandates and incentives to encourage vehicles to go further using less fuel also are playing a role in reducing the degree to which fuel prices affect transportation costs. More efficient vehicle technologies, including hybrid-electric engines, are forecast to play a significant role in decreasing the growth in oil consumption and oil imports. More efficient vehicles reduce economic reliance on low-cost fuel and limit the damage caused by oil price spikes.

Critical to stabilizing fuel costs, however, is introduction of domestic alternatives. Federal and state policies, higher fuel prices and new technologies now are creating a market for alternative fuels, although many such technologies are in the early stages of development. Biofuels, natural gas, electricity and other resources are powering a small but growing number of the nation’s vehicles. These domestically produced alternatives are free of global market influence, which promotes energy security and price stability.

State policymakers, attempting to promote economic development and, at the same time, increase energy security, are becoming more involved in developing transportation energy options. Advancing technologies are allowing states to tap local resources—whether natural gas, crops for biofuels or electricity—to fuel vehicles. To encourage development of local resources, a large array of policies has been employed.
This resource, *Transportation Energy for the Future*, explores the many options available to state policymakers as they not only address energy security and economic development, but also move toward development of a more diverse fuel supply. The report, developed by the NCSL Task Force on Energy Supply, explores issues such as:

- The economic price tag of relying on a single fuel source;
- The current and forecast trends regarding oil imports and domestic production;
- The challenges of biofuel production, new technologies, current production and future forecasts;
- Natural gas as a growing and relatively inexpensive transportation fuel;
- Diesel technology and energy efficiency;
- Electric vehicle technology; and
- Effective state policy options for increasing domestic fuel production and promoting fuel diversity.

The report aims to provide state policymakers and others with an overview of the many options available as they work toward the long-term transportation energy solutions that tap local resources, develop new industries, and shield their economies from the vicissitudes of the international oil market.
**Introduction**

Affordable and efficient transportation of people and goods are primary drivers for the nation’s economic growth. Since transportation uses nearly one-third of the energy consumed in the United States, ensuring availability of a reliable supply of transportation fuels is paramount to the long-term economic health of the nation. Unfortunately, transportation costs often are unpredictable, due to heavy reliance on oil, which has intensified or lengthened some of the nation’s latest economic downturns. A lack of transportation fuel diversity—approximately 95 percent of the country’s transportation is powered by oil—makes it more difficult to create a stable, growing economy due to erratic global oil prices.

Nearly half of the oil used in the United States is imported, some from government-owned oil companies in relatively unstable countries that may participate in collusion and market manipulation. In addition, the tendency for turmoil and political unrest in regions with the richest oil reserves drives global price instability, posing a constant threat to the nation’s energy security. Although the issue has been recognized for decades, the latest fluctuations in oil prices, combined with an increase in available alternative fuel and efficiency technologies, has given policymakers, manufacturers and innovative industries a chance to help the nation cost-effectively diversify its transportation fleet.

Although the federal government has traditionally played the greatest role in transportation energy policy, the growth of technologies such as vehicle electrification, alternative fuels, and new oil and natural gas extraction techniques has provided state policymakers with a greater ability to affect state transportation energy policy. States also influence federal policy. By adopting carbon dioxide emissions requirements for vehicles, they pushed the federal government to create higher corporate average fuel economy standards. The United States has experienced an economic downturn that has been worsened by high energy prices, increasing motivation to use more domestic resources, both for economic development and energy security. States are looking for ways to tap their energy assets and protect their governments, citizens and businesses from the economic hardships created by unstable fuel prices. This publication explores the challenges and options for state policymakers as they work to enhance domestic energy production and increase diversification of transportation fuels.

**Transportation Fuel Supply and Demand Overview**

Oil provides the nation with 95 percent of the energy used in the transportation sector; the remaining 5 percent is provided mainly by biofuels. Natural gas and a very small but growing amount of electricity also power a portion of the nation’s vehicles (Figure 1). Light trucks and passenger vehicles are responsible for about 67 percent of the transportation energy consumed yearly in the United States, while heavy-duty trucks use about 16 percent. A growing population and the need to move more goods are expected to increase transportation energy demand by 17 percent by 2035, according to the U.S. Energy Information Administration (EIA). The rate of growth is expected to be just half that of the previous 25 years, due in part to increasing efficiency. Although energy demand for light-duty cars and trucks is forecast to grow just 10 percent, energy demand for heavy-duty...
vehicles, such as freight trucks and buses, is expected to jump by nearly 50 percent (Figure 2). These forecasts are based on current policy, which requires cars to average 37.5 miles per gallon and light trucks to average 28.8 miles per gallon by 2016. The large growth in energy demand for heavy-duty vehicles is based on increased freight travel demands.

The EIA forecasts are based only on regulations in place when the analysis was developed. They do not take into account potential new policy actions. For instance, they do not include an agreement between the Obama administration and auto makers to reach average fuel economy of 54.5 miles per gallon by 2025 or new rules to increase fuel economy of medium and heavy duty vehicles by up to 20 percent by 2018.

**Figure 2. Trends in Transportation Energy Consumption through 2035**

In 2010, 49 percent of the oil consumed for transportation was imported, down from about 60 percent in 2007 due to the recession. About 5 percent of the ethanol used for transportation was imported. Nearly all electricity and natural gas are domestically produced. Although the United States has a fair amount of oil compared to most countries, it is responsible for about 20 percent of global oil consumption—more than double that of the second largest user, China. As demonstrated in Figure 3, the richest reserves lie in potentially unstable regions in the Middle East. Saudi Arabia supplies 25 percent of the world’s oil and is third highest on the list of countries that supply oil to the United States. Stable production in Saudi Arabia is critical to global oil supply, although the country has produced numerous terrorists that are hostile to the United States. Much of the oil used in the United States is imported from reliable trading partners—Canada is by far the leading supplier of oil to the United States, and Mexico ranks second.
The implications of this reliance on oil include price shocks as a result of government turmoil in other countries, natural disasters and supply disruptions within the United States, or efforts by the Organization of the Petroleum Exporting Countries (OPEC) to restrict oil production. Such volatility makes it difficult for businesses and industry to plan and budget, causing inefficient investments and creating an unpredictable operating environment. Sudden increases in oil prices inevitably lead to declines in U.S. economic productivity. Unlike some domestic resources such as biofuels, natural gas and electricity, the prices for gasoline and diesel fuel depend heavily upon global market prices for oil. Thus, increasing the domestic oil supply will not significantly affect global oil prices or the price Americans pay for gas. An increase in domestic production of oil or other fuels, however, will reduce the amount of money that goes to potentially unfriendly nations, increase energy security, decrease the trade deficit and provide for economic development within the nation’s borders.

Gasoline prices have fluctuated dramatically over the past few decades, and prices today are nearly three times higher than in 2002 (Figure 4). Oil prices significantly affect the trade deficit. Oil imports have been responsible for at least half of the U.S. trade deficit since 2007, accounting for 56 percent in 2008 and nearly 60 percent in the first half of 2011, resulting in a contribution of approximately $300 billion to the 2011 trade deficit (Figure 5). This tremendous outflow of wealth is not recycled in the U.S. economy, as occurs when oil or other fuels are produced in the United States. To finance this trade imbalance, the nation is forced to borrow or obtain investments from abroad, thus adding to its external debt.

As gasoline prices rise, consumers have less disposable income to spend on goods and services. Americans now spend an average of nearly 5 percent of their disposable income on gasoline, up from just 2 percent in 2002. Compounding the problem is the inflation caused by higher transportation and farming costs that, in turn, drive up prices of food and other goods and further constrict economic growth.

**Figure 3. Sources of U.S. Oil Imports**

![Figure 3. Sources of U.S. Oil Imports](image)


**Figure 4. Average Gasoline Retail Price**

![Figure 4. Average Gasoline Retail Price](image)

The threat of oil supply disruptions and the potential effects on the U.S. economy drive economic and military interest in the Middle East, where most of the world’s oil reserves lie (Figure 5). According to the Rand Corporation, the cost of U.S. military presence in this region is between $67 billion and $83 billion annually; an additional $8 billion is spent on military operations annually.

Despite the forecast leveling and possible decline in U.S. oil imports over the next few decades, the demand for oil is forecast to increase as countries like China and India—where only a fraction of the population now owns vehicles (Figure 6)—modernize and develop. Adding to the upward price pressure is the fact that drilling for and pumping many remaining resources, particularly in non-OPEC countries, now require more advanced and costly technologies.

Although the federal government still plays a primary role in influencing transportation energy options, a growing number of states are exploring ways to increase energy diversity to promote economic growth and stability. The following sections highlight resource options and steps states can take to promote the use of these resources, whether they be oil or alternative fuels such as natural gas, electricity, biofuels or efficiency.
Oil meets nearly 40 percent of total U.S. energy demand, and the transportation sector uses 70 percent of all oil consumed in the United States. In 2010, the United States imported 49 percent of all petroleum it used. Although the United States is the world’s largest oil importer, responsible for about 20 percent of the world’s oil consumption, it produces only 9 percent of the global oil supply each year. Still, it holds less than 3 percent of the world’s proven oil reserves, according to the U.S. Energy Information Administration.

Crude oil is produced in 31 states and in coastal waters. Domestic production peaked in 1970 and generally has decreased each year since. The United States saw a 3 percent increase in production in 2010, however, and production is expected to climb in the coming decades. In 2010, more than half of domestic production occurred in five states—Alaska, California, Louisiana, North Dakota and Texas. A third of U.S. oil was produced by offshore wells in state and federal waters in the Gulf of Mexico.

The U.S. Government Accountability Office reports that oil production will likely peak by 2040, depending on the amount of oil left in the ground, the amount that can be economically and safely produced, and future demand. Demand, which is primarily determined by economic growth, also is affected by environmental policies and shifting consumer choices. Since OPEC controls most of the world’s oil reserves and estimates are not verified by independent auditors, the amount of oil actually remaining is unknown.

More than 60 percent of world oil reserves exist in countries with unstable political conditions, which can create supply challenges. Supply disruptions in the United States caused by natural disasters and political unrest also can have dramatic effects. Figure 8 illustrates U.S. petroleum trade from 1949 through 2010.
Global and Domestic Outlook

The United States is the world’s largest petroleum consumer and third largest crude oil producer. Domestic crude oil production is expected to increase through 2035 as world oil prices rise, creating incentives for producers to develop resources such as oil shale that traditionally have been more expensive to access or process. During the same time period, offshore production in the lower 48 states is expected to increase by 13 percent, while oil shale liquid production is expected to account for about two percent of domestic crude oil production in 2035. Increased production is driven by a steady increase in oil prices, which tend to drive production more than technology advancements. Figure 9 demonstrates the costs of oil dependence to the U.S. economy in terms of wealth transfer, dislocation losses, and the loss of potential GDP.

Lawmakers can influence domestic production. The Bush administration lifted a ban on offshore drilling in portions of the outer continental shelf (OCS) in July 2008, unlocking potential development in the Atlantic and Pacific. The U.S. EIA estimates that, if the moratoria are reinstated, domestic production would decrease by a cumulative 4.2 percent between 2010 and 2030, and the average U.S. price of gasoline would be 3 cents per gallon higher. Federal laws restrict development of onshore oil resources found under national parks and monuments, including the Arctic National Wildlife Refuge in Alaska. Although the effects on the price of gasoline would be minimal, increasing domestic supply could reduce the trade deficit, create jobs and broaden the tax base, some of which is allocated to states.

Determinants of Price, Impacts of Volatile Prices on State Economies

Since oil is the leading fuel for the U.S. economy, the nation remains vulnerable to rising oil prices. High and volatile oil prices strain family and business budgets, inflate the trade deficit, and also cause price increases for other products, such as food. It is important to note that retail gasoline prices generally reflect changes in wholesale prices. However, methods for purchasing wholesale gasoline differ, depending on factors such as ownership structures, competition and regional influences, all of which can affect the price at the pump.

Natural gas prices also have been historically volatile, but they have stabilized as newly tapped shale resources drastically increased domestic supply. In contrast to natural gas prices—which are, for the most part, insulated from world markets and instead are driven by the domestic economy—oil prices are determined by worldwide changes in supply and demand. Unexpected supply disruptions such as extreme weather and geopolitical events can immediately affect prices, whereas future expectations about world oil demand and production affect prices over the long-term. Although investor speculation and competitors in the commodity trading and financial markets can further influence prices, supply and demand remain the key drivers of oil prices.
The U.S. EIA projects oil prices to increase to $125 per barrel (in 2009 dollars) by 2035, driven by the increased cost of non-OPEC supplies and a constant OPEC market share.\textsuperscript{18} The International Energy Agency 2010 World Energy Outlook finds a much different outlook, however, forecasting that oil prices will remain at more than $100 per barrel by 2015, rising to $200 per barrel by 2035.\textsuperscript{19}

Sixty percent of world oil comes from countries outside OPEC. OPEC member countries produce the remaining 40 percent, which represents approximately 60 percent of the total petroleum traded internationally.\textsuperscript{20} Actions from both non-OPEC and OPEC countries influence oil prices. While non-OPEC investment, which affects future supply capabilities, responds to changes in market conditions, OPEC countries set production targets. Since the top oil companies are owned by the government in OPEC member countries, intentional manipulation of the market can more easily occur. Oil prices generally increase when OPEC production targets are reduced, while tightening production puts upward pressure on prices.\textsuperscript{21} Such strong market influence allows events that result in actual or potential supply losses to substantially affect global oil prices.\textsuperscript{22}

On the demand side, current and expected world economic growth also influence price fluctuations. Oil consumption in countries that are members of the Organization of Economic Cooperation and Development (OECD) represented 53 percent of world oil consumption in 2010; this consumption has declined since 2000. Conversely, oil consumption in non-OECD countries increased by more than 40 percent during the same time period. Nearly all growth in oil consumption is projected to come from non-OECD countries during the next 25 years.\textsuperscript{23}

Crude oil and petroleum products can be stored for future use and to help prepare for seasonal fluctuations and emergency relief. The U.S. strategic petroleum reserve of 727 million barrels is the largest stock of government-owned crude oil in the world.\textsuperscript{24} In case oil supplies are disrupted, threatening the U.S. economy, the reserve provides a reliable option.

Market participants that buy and sell crude oil or buy futures and options in the global market also influence prices. When the flow of products to market is affected by natural disasters or geopolitical obstacles, uncertainty creates price volatility. Hurricane Katrina caused significant damage to U.S. refinery and production capacity, resulting in oil price spikes that were somewhat alleviated when the president tapped into the strategic petroleum reserve.\textsuperscript{25}

**Refining Capacity, Limits**

The last new U.S. refinery began operation in 1977; however, total net U.S. refinery capacity has increased by more than 1 million barrels per day since 2001, due to construction expansion at smaller refineries and existing plants.\textsuperscript{26} Although crude oil refining capacity was 17.7 million barrels per day in January 2011, the highest since 1982,\textsuperscript{27} refining capacity growth for oil in the United States remains bleak. Profitability of oil refineries fell during the recent economic downturn, forcing companies to close or sell. In addition, tightening fuel economy standards and increased consumption of ethanol are expected to decrease gasoline consumption growth.

EIA projects that new refining capacity will result in an additional 400,000 barrels per day by the end of 2012. After 2013, no additional capacity is expected, and refining capacity is forecast to decline.\textsuperscript{28}
Environmental Impacts

Exploring, producing, transporting and using oil can have potential harmful effects on the environment and human health. Newer pollution reduction technologies and cleaner-burning fuels have significantly reduced emissions, however. Still, transportation is responsible for about one-third of carbon dioxide (CO₂) emissions in the United States from fossil fuel combustion. Regulated transportation emissions that are considered to create unhealthy air or damage the environment include sulfur dioxide, carbon monoxide, carbon dioxide, nitrogen oxide, and particulate matter.²⁹

Improved drilling technologies—specifically horizontal drilling and hydraulic fracturing—have reduced some harmful environmental effects by allowing more oil to be extracted from fewer drilling locations. Still, drilling for oil can disturb wildlife, and oil spills from ships and platforms negatively affect the marine environment. Rapidly expanding use of advanced technologies has drawn more attention to concerns about their possible adverse effects on water and air quality.

Unconventional Sources

Because unconventional sources—such as oil sands, oil shale, and heavy and ultra-heavy oil—are more difficult to access and require complex and often more expensive technologies, it may not be profitable to develop such sources when oil prices are low. Interest in unconventional sources is gaining momentum as oil prices remain high, although concerns regarding potential environmental consequences are being raised.

At least 85 percent of the world’s proven oil sand reserves are in Alberta, Canada, which contributed 1.6 million barrels of oil per day to world oil production in 2005.³⁰ Domestic oil sand reserves are located in Alabama, Alaska, California, Texas and Utah.³¹

The largest known oil shale deposit covers parts of Colorado, Utah and Wyoming, and heavy oil can be found in Alaska, California and Wyoming.³² Heavy and extra-heavy oils require advanced technologies and significant processing to be converted into petroleum.

In addition to the technology requirements and costs associated with developing unconventional oil sources, environmental issues can be a concern. Large quantities of water are needed to produce oil from oil sand reserves, and the energy-intensive processes release more greenhouse gases than conventional oil extraction.

Coal also can be gasified and converted into a diesel-like fuel. However, high capital investments deter its widespread commercial development in the United States. Construction of a coal gas-to-liquid plant typically can take five to six years and cost up to $3.5 billion.³³

State and Federal Actions

State

The Louisiana Legislature created the Louisiana Oil Spill Coordinator’s Office (LOSCO) in 1991, funded by a 2-cent per barrel tax on oil transported to or from vessels at Louisiana marine terminals, to help respond to spills, restore resources and safeguard public health. Massachusetts enacted an Oil Spill Act in 2004 (amended
in 2008 and 2009) that requires an oil spill response and prevention fee of at least 2 cents per barrel of petroleum or crude oil extracted in the state. In 2010, Louisiana, North Carolina, New Jersey and South Carolina introduced bills relating to oil spill clean-up and proposed moratoriums on offshore drilling in response to the Deep Horizon incident. Many states also have passed resolutions recommending that Congress encourage oil and gas production.

Federal

Policymakers at the federal and state levels have been debating the potential effects increased domestic drilling might have on prices, energy security and the environment. While some recognize the potential human health and environmental risks associated with oil drilling, others aim to pass legislative measures authorizing increased drilling.

In response to concerns following the Exxon Valdez incident, the federal government enacted the Oil Pollution Act (OPA) in August 1990, which aimed to improve spill prevention and provide resources to respond to oil spills. Some states have enacted similar laws in response to accidents.
The role of biofuels as a transportation fuel is rapidly expanding, driven by federal and state incentives and requirements. In 2010, just over 4 percent of the nation’s fuel supply came from biofuels. The Energy Information Administration forecasts that at least 12 percent of the nation’s transportation fuel will come from biofuels within 25 years.

Biofuels can be produced from plants, algae, agricultural waste, food waste, municipal solid waste and other sources. Ethanol and biodiesel are the two most common types of biofuel produced in the United States. Both are mainly derived from crops that may compete with food production, such as soybean, canola, sunflowers or corn.

Since the United States has vast biomass resources, many sectors are working to improve the processes used to create biofuels from biomass. Policies have been designed to take advantage of these resources by creating incentives that drive competition, technology advancements and economic development. Because most biofuel produced in the United States comes from corn, the food versus fuel debate and environmental concerns linked to farming corn are driving policies that support production of biofuels from resources that do not compete with the food supply—such as agricultural waste, wood waste or grasses. The technology for converting these cellulosic biomass resources into biofuel remains expensive, however.

**Biofuels**

In 2010, approximately 13 billion gallons of ethanol were produced domestically, displacing gasoline produced from 445 million barrels of crude oil (Figure 10). The two common types of ethanol include starch- or sugar-based ethanol, which is derived from corn, sugar cane or similar starch-based crops; and cellulosic ethanol, which can be produced from agricultural residue, wood, grass or other woody resources. Since it is easy to extract sugars from sugar cane and corn, 90 percent of today’s ethanol comes from starch or sugar feedstock. Many see the current ethanol production from starch- and sugar-based feedstock as a stepping stone to other ethanol technologies that do not compete with food production. Although corn-based ethanol prices are

**Figure 10. U.S. Production, Consumption and Trade**

![Figure 10. U.S. Production, Consumption and Trade of Fuel Ethanol](image_url)

*Trade includes small changes in stock.*

**Source:** Worksheet available at [www.afdc.energy.gov/afdc/data](http://www.afdc.energy.gov/afdc/data); see “Data” tab for supporting data, sources, and notes.

**Ethanol**

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becoming competitive, according to the U.S. Department of Energy its use may be limited due to effects on food crops and land use. Production of alternatives, such as cellulosic ethanol, remains costly, although research is progressing quickly and several commercial cellulosic ethanol plants are under construction.37

Ethanol Blends

Three ethanol blends are produced in the United States. The most common, E10, contains 10 percent ethanol and 90 percent gasoline. More than 90 percent of gasoline in the United States is E10 due to the federal Renewable Fuel Standard and air quality requirements.38 E15-E20 blends, known as intermediate ethanol blends, contain between 15 percent and 20 percent ethanol. The EPA granted a waiver for use of E15 in 2001 in newer light-duty vehicles, and it was close to being registered for use as of March 1, 2012. E85—85 percent ethanol and 15 percent gasoline—is used to fuel E85-capable flexible fuel vehicles. More than 8 million flex fuel vehicles are on U.S. roads today; they are available for purchase from various automakers.39

Biodiesel

Like ethanol, biodiesel receives support under the Renewable Fuel Standard and various state requirements and incentives. Biodiesel is a domestically produced, renewable substitute for petroleum diesel that also is added to diesel to reduce vehicle emissions.40 In 2010, 315 million gallons of biodiesel were produced in the United States, and more than 200 million gallons were consumed (Figure 11).41 Biodiesel can be produced from soybeans, oilseed crops, animal fat, algae or recycled cooking grease.42

Biodiesel Blends and Vehicles

Biodiesel blends include B20 (20 percent biodiesel, 80 percent diesel), the most widely available blend; B2 (2 percent biodiesel, 98 percent diesel) and B5 (5 percent biodiesel, 95 percent diesel), which are becoming more common; and B100, a pure biodiesel that is not widely used.

An increasing number of cars and other light-duty vehicles can operate on diesel or biodiesel blends as a result of consumer demand for higher fuel economy. Most vehicles that operate on diesel or biodiesel blends are medium- and heavy-duty vehicles, however, which are large consumers of diesel fuel. When blend levels beyond B20 are used, the potential exists for corrosion issues to develop in engines that are not designed for biodiesel.
Biofuels Infrastructure

Ethanol

Much of the gasoline sold in the United States today is now E10 as a result of the phase-out of the oxygenate MTBE, which ethanol replaced, and renewable fuel policies. E85 stations are less common but growing quickly—more than 2,400 such stations exist in the United States. Minnesota has more than 350 E85 fueling stations, although most states have between 10 and 200.43

Biodiesel

B20 fueling stations are less common than ethanol stations and fairly uncommon in most states. North Carolina has the most stations—more than 140. Eight states have between 21 and 50 stations although most states have fewer than 10.44

Environmental Impacts of Biofuels

Growing and harvesting biomass for biofuels results in greenhouse gas emissions, although at lower levels than using gasoline or diesel. Some research indicates, however, that corn ethanol, depending on where and how the corn is grown, may offer only minimal reductions in greenhouse gas emissions or actually may increase them if grassland is converted to cornfields.45 According to the U.S. Environmental Protection Agency, the Renewable Fuel Standard will reduce carbon dioxide emissions by 138 million metric tons by 2022. Emissions of sulfur dioxide and nitrogen oxide from power plants, however, may increase due to a substantial rise in the electricity needed to produce ethanol.

The cultivation of biofuels crops, particularly those that require significant amounts of fertilizer and pesticides, have raised concerns about decreased water quality due to erosion, runoff, pollutants, leaks and spills; water consumption; conversion of forests to biomass farming; reduced soil quality; and conversion of the nation’s shrinking forest and grassland to farmland.46

State and Federal Actions

EIA predicts that, from 2009 to 2035, U.S. crude oil production will increase by about 600,000 barrels per day, while biofuels (primarily ethanol) production will increase by approximately 1.5 million barrels per day. Much of this increase in biofuels production will be the result of state and federal actions.

State

The important role of biofuels is demonstrated by the high quantity of state legislative activity in this area—all 50 states and the District of Columbia have laws and/or incentives to promote biofuels. Common incentives include tax credits, rebates, grants and loans to assist with biofuels production, infrastructure and acquisition of alternative fuel vehicles. State mandates include alternative fuel vehicle and biofuel use requirements for state fleets, emission reduction requirements, and statewide biofuel blend mandates and standards.47
Federal

Created under the Energy Policy Act of 2005, the Renewable Fuel Standard requires 7.5 billion gallons of biofuel to be blended into gasoline by 2012. In 2007, the Energy Independence and Security Act expanded the RFS program by including diesel and increasing blend requirements to 9 billion gallons by 2008 and 36 billion gallons by 2022. In addition, more than 15 federal biofuels incentives exist, including those that promote biofuels research, technology, production and infrastructure. Various tax credits, grants and loan guarantees also are available. The strong growth in the ethanol industry allowed the tax credit for conventional ethanol to expire at the end of last year, along with the tariff on imported ethanol. The $1.01 per gallon tax credit for cellulosic ethanol remains through the end of 2012.
Natural gas use in vehicles nearly doubled between 2003 and 2009 and, according to the American Public Transit Association, about 18 percent of transit buses run on natural gas. More than 100,000 natural gas vehicles (NGVs) are operating on U.S. roads, although they account for less than 1 percent of NGVs worldwide.\textsuperscript{50}

**Supply and Demand**

Natural gas is playing an increasingly important role in the nation’s energy portfolio as economically recoverable resources enhance supply and more stringent emissions requirements strengthen demand for cleaner burning transportation fuels. Advances in natural gas drilling techniques—particularly horizontal drilling and hydraulic fracturing—have opened previously inaccessible natural gas resources, expanding supplies so much that current consumption levels are expected to be sustainable for at least another century.\textsuperscript{51}

Domestic natural gas production is predicted to grow in the coming decades, reducing the need for natural gas imports (Figure 12). Shale gas is expected to be the largest source of natural gas in the future, accounting for nearly 50 percent of total U.S. natural gas production in 2035, compared to 16 percent in 2009.\textsuperscript{52}

**Transportation Consumption and Technology**

Depending on vehicle size and type, natural gas vehicles can provide better fuel efficiency, lower operating costs and reduced emissions compared to conventional fuels. Natural gas emits up to 30 percent less CO\textsubscript{2} than vehicles that run on traditional gasoline or diesel. It also emits fewer harmful pollutants, including NO\textsubscript{x}, SO\textsubscript{x} and particulates.\textsuperscript{53}

Natural gas vehicle operation is similar to that of gasoline-powered vehicles, although modifications to the fuel storage tank, engine and fueling nozzle must be made for NGVs to run efficiently. Most NGVs use compressed...
natural gas (CNG), which is stored in high-pressure in cylinders. Liquefied natural gas (LNG), which requires less space to store the same amount of energy as CNG, is used mainly in large vehicles such as semi-trailer trucks. Some vehicles are designed to use both gasoline and natural gas. Improved technology allows production of all types of NGVs, including cars, trucks, buses and utility vehicles. Although some disadvantages still prevent mass deployment, industry is working with automakers and developing fueling corridors to address challenges—such as range limitations, lack of fueling infrastructure, and higher up-front costs.

**Fleet Conversion**

Cities across the country have significant fleets of natural gas buses, and leading U.S. corporations also have invested in natural gas transportation. School buses in Ardmore, Pa., and trash trucks in Cleveland, Ohio, are among the municipal fleets that have converted to natural gas. Los Angeles has the largest fleet of compressed natural gas buses in the nation, retiring its last diesel buses in 2011.

Verizon and UPS also are investing in natural gas. Verizon committed to add 1,600 alternative fuel vehicles to its fleet during the next year, including 300 new CNG cargo vans. UPS recently added 245 new CNG-fueled delivery trucks for use in cities in Colorado and California, bringing its CNG vehicle total to more than 1,100 trucks.

**Fuel Prices**

The per-gallon price of natural gas typically is about half that of traditional fuels; as of July 2011, compressed natural gas cost about $1.61 less than gasoline per gallon on average. As use of natural gas vehicles becomes more common, some fleet managers may find these vehicles have lower operating and maintenance costs and can pay for retrofit costs with fuel savings. Many fleets report a 15 percent to 28 percent savings compared to diesel fleets. The bigger and busier the vehicle, the greater the benefits are of switching to natural gas.

Natural gas prices are not projected to return to the high levels experienced before the recent recession. Past fluctuations have been major drawbacks to heavy reliance on natural gas; expanding domestic supplies as a result of the availability of shale gas are expected to help sustain lower prices and mitigate price volatility, however. Regional differences also can affect prices. The U.S. Department of Energy estimates that the average wellhead price of natural gas will increase to $6.26 per million Btu in 2035 (in 2009 dollars), an average of 2.1 percent per year, but prices are not expected to pass $5 per million Btu until 2024 (Figure 13). Projections range and prices will depend on economic growth, regional differences and technology improvements.
Environmental Impacts

Natural gas is an attractive transportation fuel because it burns cleaner than other fossil fuels. Natural gas vehicles produce up to 30 percent less greenhouse gas emissions than comparable gas or diesel vehicles.58

Although natural gas transportation can provide environmental benefits, the rapidly expanding use of hydraulic fracturing has drawn attention to water use and the potential effects of fracking fluid on human health and the environment. Many states and the federal government currently are working to improve regulatory oversight of and environmental standards for fracking.

State and Federal Actions

State

States are actively deploying natural gas vehicles as part of their effort to promote alternative fuels. Although infrastructure costs remain high, many states offer financial incentives for infrastructure and vehicles purchased though tax incentives, rebates and financing programs. Arkansas, for example, enacted HB 1914 in 2011, which created rebates for a kit that converts diesel or gasoline motor vehicles to a bi-fuel compressed natural gas vehicle. Other states allow natural gas vehicles to use high-occupancy vehicle lanes or exempt them from state emissions inspections. Of those that provide incentives, 36 states and the District of Columbia provide them for the owner/driver of the vehicle, and 36 states provide them for alternative fuel purchasers and producers or dealers.59

State fleet requirements also are strong incentives, although advantages are greatest for centrally fueled fleets. At least 37 states and the District of Columbia require certain state departments to retrofit current vehicles or to purchase natural gas vehicles.

Federal

Policymakers have encouraged natural gas vehicle development with tax incentives, rebate programs and fleet requirements. At the federal level, natural gas vehicle manufacturers and purchasers are eligible for alternative fuel tax credits and exemptions, as well as for a loan guarantee program for projects that reduce air pollution and support early commercial use of advanced technologies.


**DIESEL TECHNOLOGY**

Although diesel fuel is used primarily for heavy-duty on-road commercial transportation and non-road transport, it also plays an expanding role in the light-duty passenger vehicle market. As Corporate Average Fuel Economy (CAFE) standards tighten, manufacturers are likely to build more diesel vehicles, which get better mileage than their gasoline counterparts. Diesel-fueled vehicle sales are expected to grow to 5 percent of total light-duty vehicle sales and 13 percent of unconventional vehicle sales by 2035, driving diesel consumption; gasoline consumption is expected to decrease (Figure 14).

Although the U.S. Energy Information Administration forecasts that the nation’s total refining capacity will decline after 2013, the share of diesel refining capacity may grow as consumption increases.

**Pricing**

Global demand for diesel fuel and distillate fuel oils—which can be used as heating oil, diesel engine fuel and electric power generation—has increased at higher growth rates than gasoline, catching up to the refiners’ ability to supply the market and putting pressure on global refining capacity. Making the transition to ultra-low sulfur diesel (ULSD) fuel in the United States also affected fuel production costs. The federal excise tax on diesel is 6 cents per gallon higher than it is on gasoline.

**Environmental Impacts**

Concerns about harmful air pollutants have created demand for cleaner, more efficient fuels, but concerns have largely been reduced as a result of the new ultra-low sulfur diesel fuel introduced in 2006. Refining improvements have reduced fuel sulfur levels by 97 percent, while EPA emissions control requirements have further reduced air pollutant emissions from diesel vehicles. Implementation of more stringent EPA standards and

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*Figure 14. U.S. Motor Gasoline and Diesel Fuel Consumption, 2000-2035 (million barrels per day)*

improved technologies make new technology cleaner, although it will be a long time before new cleaner-burning diesel vehicles will replace older ones.66

Technologies and Efficiency

Diesel fuel has higher energy content than gasoline, and diesel engines also are efficient, with a fuel economy of up to 40 percent better than similar gasoline vehicles. Most diesel vehicles and equipment also are compatible with biodiesel fuel blends.67 Using biodiesel blends reduces emissions and provides the opportunity to use domestically produced fuels. Most car manufacturers provide a warranty on fuel blends of up to 5 percent biodiesel (B5), while heavy-duty manufacturers will warranty fuel blends of up to 20 percent biodiesel (B20).

Also being introduced is diesel electric hybrid technology that can improve fuel economy by 20 percent to 50 percent when applied to medium- and heavy-duty vehicles.68 Two of the most popular applications are in transit buses and work trucks. According to the American Public Transportation Association, the 20 largest U.S. transit districts ordered more diesel hybrid buses than standard diesel buses. General Motors introduced a hybrid diesel-electric military truck in 2003, and Caterpillar, a U.S. construction company, has released diesel-electric tractors. According to a report from Pike Research, 300,000 hybrid trucks and buses will be on the road in 2015, 10 times more than in 2010.69

Heavy-duty diesel emissions have declined rapidly due to a combination of ultra-low sulfur diesel and advanced emission control technologies. Diesel particulate filters, which have been standard on all heavy-duty trucks since 2007, have dramatically reduced particulate matter emissions.

In March 2010, a report by the National Research Council recognized that advanced technologies can improve the fuel economy of medium- and heavy-duty vehicles; it noted that technology improvements are cost-effective. Large corporations that depend on diesel-fueled fleets can work toward deploying clean technologies that will reduce both fuel costs and air pollutants. For example, Walmart has succeeded in replacing almost two-thirds of its fleet with efficient tractors; it delivered 57 million more cases but drove 49 million miles less in 2010.70 Since 2005, Walmart has achieved a 65 percent increase in fleet efficiency and aims to double its truck fleet efficiency in the United States by October 2015.71

State and Federal Actions

State

The two largest state programs include California’s Carl Moyer Program, which grants up to $140 million a year for cleaner-than-required engines and equipment, and the Texas Emissions Reduction Plan. Other notable programs are found in Ohio and North Carolina; however, few other states have dedicated state funding for diesel retrofit programs.72 In Maine, the Clean School Bus Program is retrofitting more than 400 school buses, and Massachusetts also has a successful school bus retrofit program.
Rebate programs can further provide incentives for small businesses to upgrade their diesel vehicles in order to improve efficiency and emissions, and tax incentives in some states encourage use of cleaner fuels. In Connecticut, diesel reduction initiatives exempt taxes on air pollution control equipment, and a tax credit in Oregon pays for up to 35 percent of the cost of a clean diesel retrofit. Financing options for projects that will help improve air quality—such as idle reduction technology projects—also are common. Since upgrades can be costly but pay for themselves in fuel savings, financing policies can make it easier for smaller companies to carry out such upgrades.

**Federal**

Ultra-low sulfur diesel (ULSD) became available nationwide in 2006, and all 2007 model year and newer diesel-powered highway vehicles were required to use it. EPA required all highway diesel fuel to be ULSD by December 2010, and all diesel fuel sold for other uses must meet this standard by 2014. Off-road equipment was required to use ULSD by June 2010, and locomotive and marine applications must use it by 2012.

New rules from EPA and the National Highway Traffic Safety Administration set fuel efficiency standards for trucks, buses and other heavy-duty vehicles. As a result, trucks and buses built from 2014 to 2018 are projected to reduce oil consumption by 530 million barrels and to significantly reduce greenhouse gas pollution. By model year 2018, combination tractors must reduce fuel consumption and greenhouse gas emissions by 20 percent, heavy-duty pickup trucks and vans by up to 15 percent, and vocational vehicles (buses, garbage trucks, etc.) by 10 percent.

The 2005 Energy Policy Act created the Diesel Emissions Reduction Program, a voluntary incentive program administered by the EPA. One component, the State Clean Diesel Program, provides funding to states to help reduce emissions from heavy-duty diesel engines. More than 1,000 clean diesel state programs exist, most commonly as grant programs. EPA also runs the SmartWay Transport Partnership, which helps truck carriers assess, calculate and track efficiency through fuel economy and emissions. Since 2004, SmartWay partners have saved 50 million barrels of oil—the equivalent of taking 3 million cars off of the road for a year.
Electric Vehicles

Electricity may play a significant role in meeting future U.S. transportation energy needs. Since the vast majority of electric generation resources are domestic, electric vehicles are viewed as an excellent way to diversify transportation fuels. Although some challenges remain in regard to cost and battery technology, the availability of domestic electricity is not an issue so long as vehicles are charged at night, when more electric generating capacity is available.

Electric vehicles (EVs) are becoming more popular in the United States due to incentives, advanced motor and battery technologies, higher gasoline prices and environmental concerns. Although electric cars are more expensive than gasoline vehicles, fueling them is far less expensive. With the national average price of residential electricity at approximately 11.5 cents per kilowatt hour, a vehicle that runs only on electricity can travel approximately 30 miles on about 80 cents of electricity—almost one-fourth of the cost of driving a similarly equipped car at $3 a gallon for gasoline.

Electricity prices fluctuate far less than oil prices, so increased reliance on electricity for transportation could help make transportation costs more predictable and reduce the negative economic effects of oil price fluctuations (Figure 15).

Types of Electric Vehicles

Hybrid electric vehicles (HEVs) have an internal combustion engine, an electric motor and a rechargeable battery that provides extra power and is charged by the engine and by recapturing energy from braking. Hybrid vehicles increase gas mileage by about 30 percent. Approximately 1.9 million HEVs operate on U.S. roads.

Plug-in hybrid electric vehicles (PHEVs), introduced in 2011, have a larger battery that can be charged from an electrical outlet and can run solely on electricity for 10 to 40 miles before the gasoline engine engages to power...
the motor. The Chevrolet Volt and the Toyota Prius Plug-In Hybrid (available Spring 2012) are the only two PHEVs that are commercially available in the United States, although some other companies plan to release plug-in hybrid vehicles in 2012. Since most people drive an average of less than 30 miles per day, plug-in hybrids enable many to complete their daily driving solely on the electric charge, providing the vehicle is charged each night.

Electric vehicles do not have combustion engines; they operate purely from energy stored in the battery pack. EVs are more expensive than combustion engine vehicles due to the high cost of batteries. EVs can travel between 100 miles and 300 miles per charge; most of those currently available in the United States can travel 100 miles or less per charge. The least expensive EV on the market today costs around $33,000. Mitsubishi’s EV, to be released in 2012, will cost $27,000. Some up-front costs of purchasing EVs can be recovered through various federal and state incentives, which can save purchasers up to $10,000.81

Infrastructure

Electric vehicles are charged with charging units that can be installed at home, the workplace or in public areas. Federal, state and auto manufacturer incentives are helping consumers pay for home charging units, which cost about $1,500. Fewer than 4,000 public EV charging stations currently are available in the United States; more than 1,200 are in California, and most states have fewer than 50.

With so few public charging stations, operating a purely electric vehicle for long trips requires drivers to plan ahead by estimating mileage and identifying charging station locations. For EVs to appeal to a wider range of consumers, a broader charging infrastructure in workplaces, malls and other public places may be necessary.

Through the Transportation Electrification Initiative, which received $400 million under American Recovery and Investment Act funds, numerous companies are installing charging infrastructure. In 2009, ECOtality was awarded a $99.8 million grant from the U.S. Department of Energy to launch the EV Project. The project’s goal is to deploy 14,000 EV chargers in 18 major U.S. cities. The EV Project, with Chevrolet and Nissan as partners, also promotes residential charging stations. Volt and Leaf drivers who qualify to participate in the project receive residential chargers at no cost.

Electric Vehicle Impacts on Utility Rates and Electricity Supply

Widespread use of EVs could increase demand for electricity, although research suggests that the existing U.S. electricity infrastructure has enough capacity to fuel 73 percent of the nation’s light-duty vehicles.82 Since much of this capacity is available only at night, charging a large number of electric vehicles during the day, could overload generation capacity and distribution networks, requiring costly electric grid upgrades and construction of new power plants.83 Some solutions to this dilemma include smart EV charging systems that charge vehicles during off-peak hours or allow a utility to limit charging when demand is high; and time-of-use electric rates that are higher during peak hours and lower at night.84 Adopting smart grid technologies will be an important component to incorporating electric vehicle charging into the electric load.
Environmental Impacts

Electric vehicles themselves have zero emissions, although generating the electricity to power the vehicle is likely to create air pollution. Depending on where in the United States the EV is charged, its power will come from a varying mix of coal, natural gas, nuclear and renewable energy (Figure 16). In most areas of the United States, emissions created by an electric vehicle are likely to be less than those of a gas-powered vehicle. Since most power plants are not in city centers, removing emissions from the vehicle improves air quality in areas that experience transportation-related air pollution problems.

Manufacturing the batteries to power electric vehicles is energy intensive, so building an electric vehicle produces more greenhouse gas emissions than building a similar-size gasoline powered vehicle. Over the vehicle’s lifetime, the lower operating emissions counter this emissions debt however, according to analysis conducted by Ricardo.

State and Federal Actions

State

Some of the strongest incentives are rebates or tax credits that range from $750 to $7,500 for purchase of an electric vehicle. States also have a variety of other incentives, including preferences for state fleets, state fleet acquisition requirements, emission test exemptions, parking regulations and allowing EV use of high-occupancy vehicle lanes.

Thirty-three states have incentives that promote development of public EV charging stations. Most of these incentives are tax credits and exemptions, grants, loans and infrastructure development programs.

Federal

Twenty-four federal laws, incentives and programs promote EVs and EV infrastructure, although the most important may be the federal EV tax credit—$7,500 for all fully electric vehicles sold in the United States. The tax credit expires for each EV manufacturer after it sells a minimum of 200,000 vehicles. Other incentives include electric charging infrastructure tax credits, research project grants, improved energy technology loans, manufacturing incentives, requirements for federal fleets, and procurement preferences. More than 10 federal programs also promote EVs and EV infrastructure.

Figure 16. Sources of U.S. Electricity Generation, 2010

TRANSPORTATION FUELS: POLICY OPTIONS

Petroleum

Since the United States imported 49 percent of the petroleum it consumed in 2010, policies that decrease consumption through efficiency and increase U.S. production can help increase the percentage of domestic oil the nation produces and uses. Reducing the demand for imported oil will allow the nation to more selectively choose its oil trading partners, since some current partners are either unstable government entities or hostile to the United States.

1. Set Oil Consumption Reduction Targets
Creating a goal for oil consumption reduction and developing a plan to meet that goal can help states promote domestic resources and transportation energy diversity. Maine passed legislation (LD 553, 2011) requiring development of a plan to reduce the state’s oil consumption of at least 30 percent from 2007 levels by 2030 and by 50 percent by 2050.

2. Encourage Efficient Vehicle Procurement
Lawmakers can require the state to purchase fuel efficient vehicles to lower fuel consumption and decrease energy costs. At least 26 states require some sort of fuel efficiency criteria when purchasing state vehicles. Alabama’s Green Fleets Policy outlines procedures for procuring state vehicles based on fuel economy criteria. Connecticut requires state agencies to purchase cars and light-duty trucks that have an average U.S. EPA-estimated fuel economy of at least 40 mpg, and Delaware state agencies must reduce petroleum consumption by 25 percent. Minnesota requires state agency vehicles to reduce gasoline consumption by 50 percent by 2015 compared to 2005 levels.

Some states also offer rebates and tax incentives for fuel efficient or hybrid gasoline-electric vehicles. The District of Columbia reduces registration fees and allows tax exemptions on original certificates of title for vehicles purchased that have a fuel economy of at least 40 mpg.

3. Open Domestic Land and Water for Oil Drilling
States can decide to open or close state land and coastal water for drilling. Ohio, for example, enacted HB 133 (2011) to establish a procedure for leasing state-owned land for oil and gas production. The bill excludes nature preserves from drilling. In 2010, Oregon enacted 3613a to prohibit leasing for exploration, development or production of oil, gas or sulfur in territorial seas.
Virginia enacted SB 394 (2011) to support oil and natural gas exploration, development and production off the state’s coast. Similarly, HB 787 (enacted in 2010) states the Commonwealth’s policy to support and permit oil and natural gas exploration, development and production 50 miles or more off the coast.

4. Create Tax Incentives for Producing Oil
State lawmakers can provide tax incentives to encourage oil and gas production, which can induce more exploration and extraction within the state. Many states provide tax incentives related to oil production. North Dakota, for example, extended tax exemptions for extracting oil from the gross production tax with HB 1467, enacted in 2011. In 2010, Oklahoma enacted HB 2432, which provided tax breaks for oil and gas producers. Virginia enacted SB 1343 in 2011 to provide commercial and industrial tax exemptions, extending the sunset date for the retail sales and use tax exemption for property used in drilling, extraction or processing of natural gas or oil.

5. Allow Enhanced Oil Recovery Credits
Unconventional sources—such as oil sands, oil shale, and heavy and ultra-heavy oil—often are difficult to access and may require use of expensive technologies. Higher oil prices are driving an increased interest in this resource, however. States can promote use of unconventional resources through financial incentives. Texas law (§202.054), for example, provides tax credits for oil produced from enhanced recovery.

6. Increase Imports from Neighboring Countries—Keystone Pipeline
Much of the world’s proven oil sand reserves are in Alberta, Canada. The Keystone XL 1,700-mile crude oil pipeline stretching from Alberta to Texas would be able to transport 830,000 barrels of oil per day to the United States. The project, forecast to create thousands of jobs, also would reduce the need for oil imported from less friendly trading partners. Many are against the proposal due to environmental concerns about greenhouse gas emissions and extraction methods.

Recognizing the economic and energy security benefits as well as the environmental concerns, state lawmakers are debating whether to urge Congress to approve the project. Michigan, Ohio and Oklahoma have passed resolutions supporting construction of the pipeline. Nebraska, however, opened a special session to discuss environmental concerns about the pipeline’s path.

7. Set Fees to Fund Environmental Protection
Alleviating the environmental concerns related to oil drilling is a key component to domestic extraction. Policy approaches include creating screening, reporting and risk-based monitoring programs, as well as fees to fund oil spill prevention programs. Some state lawmakers also are seeking ways to prevent oil spills. California, which already has an oil spill fee, enacted AB 1112 in 2011. It requires identification and monitoring of the high-risk operations relating to oil transport by sea. The law also requires a report on regulatory action to ensure maximum safety and harm prevention during offshore oil drilling.

To raise money for environmental protection related to fuel use, 11 states have added small fees—ranging from .1 cent to 1 cent per gallon—to the tax on each gallon of fuel sold.
Biofuels

1. Set Renewable Fuel Standards
Renewable fuel standards require that a certain percentage of fuel sold in a state contains a specified percentage of biofuel. Although a national renewable fuel standard (RFS) exists, many states are taking the initiative to develop renewable fuel standards to supplement both gasoline and diesel fuel. Twelve states have renewable fuel mandates, standards or goals. Minnesota requires that diesel fuel sold in the state contain 5 percent biodiesel, increasing to 20 percent by May 1, 2015. It also requires that 20 percent of the fuel sold in the state be ethanol by 2013. Iowa requires that 25 percent of fuel sold in the state be biofuels by 2020.

2. Create Biofuel Production and Distribution Incentives
Corn ethanol has become a major U.S. biofuel because it is easily produced and can be used as a fuel additive in conventional gasoline. Still, the food versus fuel and environmental concerns have raised concern about ethanol requirements. By recognizing these issues, policymakers can develop policies to address them.

To promote use of ethanol and biodiesel fuels, more than 35 states offer incentives—including tax credits and exemptions, loans and grants—to biofuel producers and distributors. Some states are lowering production tax credits for corn ethanol—which many say can operate easily with federal incentives only—but are maintaining incentives for cellulosic ethanol.

3. Create Biofuels Infrastructure Development Incentives
Since infrastructure is critical to producing and dispensing biofuels, more than 20 states offer incentives to promote development of a fueling infrastructure for biofuels. Most of these incentives are tax credits, loans and grants to fueling station owners and developers who convert or install new systems that provide ethanol or biodiesel blends to the public.

4. Create Alternative Fuel Vehicle Purchase Incentives
To promote individual purchase of vehicles that use ethanol or biodiesel as fuel, more than 10 states offer alternative fuel vehicle tax credits or exemptions, rebates and loans to state residents and businesses.

5. Set Alternative Fuel Fleet Acquisition/Biofuels Use Requirements
Since state fleets can be large consumers of fuel, many states have created laws to promote or require their fleets to purchase biofuels and acquire vehicles that use biofuels. In Colorado, diesel-powered state-owned vehicles must use B20 if the price difference is 10 cents or less. In Illinois, state agencies must purchase flex fuel vehicles that can run on E85 blends and B5 biodiesel blends.
Natural Gas Vehicles

1. Consider Infrastructure Accessibility and Affordability

Natural gas vehicle (NGV) fueling infrastructure is on the rise in the United States due to a convergence of company efforts to convert fleets and local government concerns about transportation costs and air quality. Approximately 110,000 NGVs are on U.S. roads today, using more than 1,000 natural gas fueling stations. California and New York lead the nation in number of natural gas refueling stations (Figure 17).

Natural gas fueling corridors make fueling more accessible. In partnership with UPS, the South Coast Air Quality Management District is completing a 700-mile natural gas corridor from Las Vegas, Nev., to Ontario, Calif. In addition to providing fuel for more than 200 UPS heavy-duty vehicles, the stations would be accessible to all natural gas vehicles.

State policies—including Texas’ SB 20, enacted in 2011—help create these corridors. This law created a program to provide grants for 50 percent of eligible costs to construct, reconstruct or acquire a facility to store, compress or dispense alternative fuels such as natural gas, hydrogen, electricity and others. The Texas Commission on Environmental Quality administers the NGV grant program to promote replacement of existing medium- and heavy-duty vehicles with new, converted or repowered NGVs.

Indiana’s Alternative Fueling Station Grant Program (Indiana Code 4-4-32.2) provides up to $20,000 for installing new alternative fueling stations or converting existing fueling stations, including liquefied petroleum gas and compressed natural gas. Ohio’s Alternative Fuel Transportation Grant Program (Ohio Revised Code 122.075) provides up to 80 percent of the costs for installing and purchasing fueling facilities that offer natural gas, and Louisiana provides an income tax credit of 50 percent of the cost of converting a vehicle and 50 percent of the cost of constructing an alternative fueling station.

2. Create Vehicle Fleet Conversion Requirements

Converting fleets to natural gas can result in cost savings and improve local air quality. Many fleets see a 15 percent to 28 percent fuel savings compared to diesel fleets. At least 37 states and the District of Columbia require certain state departments to retrofit current vehicles or to purchase NGVs.

Wyoming enacted HB 235 (2011) to require certain state departments to acquire natural gas vehicles through retrofit or purchase. Oregon’s HB 2960, enacted in 2011, directed the Oregon Department of Energy to provide grants and loans to retrofit school bus fleets to operate on compressed natural gas or other alternatives. In 2010, Utah enacted HB 70, which allows CNG retrofits that comply with state requirements, regardless of whether they are EPA-certified, providing a significant savings in conversion costs. It also allows the Clean Air Board to require conversion of fleets and heavy duty vehicles in areas that are not meeting EPA Clean Air Act requirements.
3. Provide Tax Incentives, Rebate Programs and High-Occupancy Vehicle Lane Exemptions

Policymakers can encourage natural gas vehicle deployment by creating a variety of incentives. At least 25 states provide tax credits, exemptions or refunds for alternative fuel use, fuel production, or infrastructure. Fifteen states have loan or lease programs, 10 have implemented rebate programs, and 17 states and the District of Columbia have high-occupancy vehicle (HOV) lane or emission inspection exemptions for natural gas vehicles. Of the states providing incentives, 36 and the District of Columbia provide them for vehicle owners, and 36 have them for alternative fuel purchasers, sellers or producers.

California’s Senate Bill 1340, enacted in 2010, provides grants and loans for alternative and renewable fuel projects. Georgia provides an income tax credit of 10 percent of the cost, up to $2,500, per vehicle to purchase or lease a new alternative fuel vehicle. West Virginia’s alternative fuel vehicle income tax credit is available for 35 percent of the vehicle purchase price or 50 percent of the vehicle conversion cost. The credit is capped at $7,500 for vehicles weighing up to 26,000 pounds and at $25,000 for those weighing 26,000 pounds or more. In the 2011 legislative session, at least six states enacted legislation to provide exemptions or rebates or to require fuel fleet conversions for alternative fuels, including natural gas. Arkansas HB 1914, for example, created rebates for converting a diesel or gasoline motor vehicle to a bi-fuel compressed natural gas vehicle. North Carolina enacted SB 194 to authorize CNG vehicles to operate in HOV lanes.

Diesel Technology

1. Create Diesel-Electric Hybrid Incentives

Diesel-electric hybrid technology can improve fuel economy of medium- and heavy-duty vehicles by 20 percent to 50 percent. Since fuel costs often are significant for businesses that rely on larger vehicles, increased efficiency not only can provide significant savings, but also can reduce the demand for oil. Incentives for diesel electric hybrid vehicles can help establish the new technology until costs decrease. Colorado passed legislation in 2011 (HB 1018) providing income tax credits for diesel-electric hybrids until 2016. The credits cover light-duty passenger vehicles and trucks, medium-duty diesel-electric truck conversions, and new diesel-electric medium-duty trucks.

2. Create Idle-Reducing Technology Incentives

Since an idling truck burns almost a gallon of diesel fuel per hour, reduced idling can save operators more than $3,000 in fuel costs annually. To reduce diesel emissions and improve air quality, anti-idling laws and support for truck stop electrification can significantly reduce fleet fuel consumption. Truck stop electrification provides trucks with electrical power, allowing drivers to run lights, heaters and other necessities during mandatory rest periods.

A 10 percent income tax credit for equipment and installation costs is available in Georgia for those who install diesel particulate emissions reduction technology equipment at a truck stop, depot, or other facility.
The equipment must provide for heat, air conditioning, light, and communications for the drivers of heavy-duty commercial motor vehicles parked at a truck stop, and when the technology in use, the engine must be turned off.

Many states also allow additional weight for vehicles that use idle-reduction technology to reduce fuel use and emissions. In 2011, New Hampshire enacted HB 117 to permit up to an additional 400 pounds in gross, axle, tandem or bridge weight limits.

3. Set Idling Restrictions
Idling restrictions also reduce fuel consumption and improve air quality. At least 22 states and the District of Columbia have implemented statewide idling restrictions, although limits vary and most states provide weather- or traffic-related exemptions. New Jersey, for example, limits idling to three minutes in a one-hour period, or 15 minutes if the temperature is below 25 degrees and the vehicle is stopped for more than three hours. While loading or unloading passengers, diesel buses can idle for 15 minutes.

4. Create Efficiency Technology Incentives
Aerodynamic drag significantly reduces fuel economy for trucks at highway speeds, but resistance can be reduced by streamlining heavy-duty vehicles. For example, fairings and single-wide-base tires can improve fuel economy by reducing resistance and weight. State incentives can encourage use of more efficient technologies by offsetting costs to truck owners, including grant programs, state tax credits, loans and lease-to-own programs.

The Arkansas Department of Environmental Quality offers small business loans for pollution prevention, including idle-reduction technologies, low-rolling resistance tires, and tractor aerodynamic technologies. Oregon’s Business Energy Tax Credit offers a tax credit of 35 percent for purchasing efficient truck technologies, including aerodynamic packages and single-wide tires.

5. Create Monetary Incentives for Clean Diesel
Rebate programs can encourage small businesses to participate in purchasing diesel vehicles or retrofitting vehicles. Pennsylvania’s program provides rebates for particulate filters and closed crankcase ventilation systems on school buses. Two programs in Texas provide similar clean diesel incentives.

Tax exemptions and credits encourage diesel retrofits. In Connecticut, for example, the diesel reduction initiatives exempt air pollution control equipment from taxes, and a tax credit in Oregon pays for up to 35 percent of the cost of a clean diesel retrofit.

States also can provide financing options for clean diesel vehicles or technologies. These could take the form of leasing-to-own, idle reduction technologies, or air quality project financing. The U.S. EPA provides tools and recommendations for designing incentives, which can be accessed at http://epa.gov/otaq/diesel/tools/funding.htm.

6. Reduce Highway Speed Limits
When a line-haul truck with 90 percent highway miles reduces its top speed from 70 mph to 65 mph, this can save $1,500 in fuel costs. Maximum speed limits are set by the state, and lawmakers can reduce speed limits for certain vehicles to reduce diesel consumption. A pending bill (SB 504) in South Carolina would provide maximum speed limits for state-operated motor vehicles; reducing speed limits for state-operated motor vehicles on state highways would reduce fossil fuel consumption and save the state money. The state aims to set an example of how to reduce dependence on foreign oil.
Electric Vehicles

1. Resolve Fuel Tax Issues
The nationwide average tax on gasoline is approximately 48.8 cents per gallon, which provides funding to maintain highways and roads. Since both state and federal gasoline taxes have not kept up with inflation, states are seeing shortfalls in funding for roadway maintenance and construction. The addition of hybrids, more efficient vehicles and electric vehicles further exacerbate the problem by reducing gas consumption and tax income. To ensure that drivers pay a fair share of roadway infrastructure costs, states can explore many income alternatives, such as mileage-based taxation, additional registration fees and tolling. At least five states require additional registration or decal fees for electric vehicles to help mitigate loss of funding for highways and roads.97

2. Create Infrastructure Development Incentives and Requirements
Since charging stations are critical to successful electric vehicle use, more than 20 states offer tax credits and exemptions, grants and loans to promote EV infrastructure development. In some states, utilities also are starting to promote EV charging during off-peak hours. To help decrease impacts on the electric grid, many utilities offer time-of-use rates and other incentives for EV operators who install time-of-use meters.

To further promote infrastructure development, at least three states have considered requiring parking lot owners to reserve a certain number of parking spaces for electric vehicles.

3. Create Electric Vehicle Purchase Incentives
Since the cost to purchase an electric vehicle still is relatively high, more than 18 states offer financial incentives—such as tax credits, tax exemptions, grants and loans—for EV purchase. Other incentives include HOV lane exemptions, emission test exemptions and parking incentives. At least 10 states allow EVs in high-occupancy vehicle lanes, regardless of the number of passengers. More than five states provide emission test exemptions for EV owners. Two states give priority or free parking to EVs.99

4. Set Alternative Fuel Fleet Acquisition Requirements
Since state purchasing power is significant enough to affect the electric vehicle market, state fleet requirements may promote alternative fuel vehicles. Laws and regulations in more than 30 states require state fleets to purchase a minimum number of alternative fuel vehicles, including electric and hybrid-electric vehicles.
NOTES

2. Ibid.
13. Ibid.
15. Ibid.
16. Ibid.
27. Ibid.
29. U.S. Energy Information Administration, “Oil: Crude and Petroleum Products Explained, Oil and the
32. Ibid.
33. Ibid.
34. National Conference of State Legislatures, 2010 Offshore Oil Drilling Legislation (Denver, Colo.: NCSL, n.d.);
39. Ibid.
44. Ibid.
51. This is according to research conducted by the Potential Gas Committee at the Colorado School of Mines in 2009. See www.mines.edu/Potential-Gas-Committee-reports-unprecedented-increase-in-magnitude-of-U.S.-natural-gas-resource-base.
52. Ibid.
58. Natural Gas Vehicles for America, NGVs and the Environment.
64. Diesel Technology Forum, “About Clean Diesel” (Frederick, Md.: DTF, n.d.); http://www.dieselforum.org/index.cfm?objectid=99731D0B-3D1-11E0-861B000C-296BA163.
66. U.S. Energy Information Administration, Diesel Fuel and Engines Are Getting Cleaner (Washington, D.C.:


71. Ibid.


74. Ibid.

75. U.S. Energy Information Administration, Diesel Fuel and Engines Are Getting Cleaner.


88. Ibid.


91. Ibid.


94. U.S. Environmental Protection Agency, SmartWay Transport Partnership, Overview of Carrier Strategies.

95. Ibid.


98. Ibid.

99. Ibid.
Transportation Energy for the Future
A Guide for Policymakers

Transportation Energy for the Future: A Guide for Policymakers helps policy leaders who are addressing the challenges facing their states as they begin to diversify the transportation energy supply. The guide investigates the economic effects caused by reliance on a single fuel source to power the nation’s transportation, which remains a critical engine for the country’s economic growth. It also explores the long-term outlook for transportation energy; the rise of domestic alternatives, including electricity, natural gas and biofuels; and the many policies state lawmakers can use to encourage fuel diversity in the transportation sector.

The report was developed under direction of the NCSL Task Force on Energy Supply, which was formed in 2009 to consider potential solutions to the nation’s energy challenges. The goal of this report is to facilitate discussions within each state to define energy needs and determine policies that will best achieve reliable, efficient and cost-effective transportation energy solutions.

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