Module Objective
Upon the completion of this module, participants will be able to describe the use and continued growth of ethanol and ethanol-blended fuels (EBF) in the United States.

Enabling Objectives
1. Describe the differences between gasoline and ethanol-blended gasoline as fuels.
2. List the three most common ethanol-blends.

Instructor Note:

* Module Time: 30 minutes/40 minutes
* Materials:
  - Emergency Response Considerations video – (Show the video segment from 0:00 to 4:48)
  - Responding to Ethanol Incidents video – (Total time 19:20)
Introduction

Ethanol, what is the worry?

- On May 14, 2007, a tanker carrying 8,000 gallons of ethanol overturned and burst into flames on an interstate in Baltimore, Maryland, killing the driver and sending a burning stream of ethanol into the street below, igniting a row of parked vehicles.
- On October 20, 2006, a train carrying eighty-six-car of ethanol derailed in New Brighton, Pennsylvania, twenty-three cars derailed and approximately twenty of those cars released product. Some of the tank cars went into a river while others burst into flames.
- On June 18, 2006, in Missoula, Montana, five ethanol tank cars in a seventy-five-car train derailed at the Montana Rail Link (MRL) switching yard. One car leaked approximately 12,000 gallons of ethanol before emergency crews were able to stop the leak.
- On March 3, 2004, an ethanol bulk storage tank containing approximately 1,850,000 gallons exploded and burned in Port Kembla, New South Wales (NSW), Australia. The explosion blew the roof of the tank 100 feet in the air, landing next to the tank, and damaging firefighting equipment for the whole facility.

Instructor Note:

Show the video Emergency Response Considerations (0:00 to 4:48). This video was produced by the Ethanol Emergency Response Coalition (EERC).

The addition of ethanol to gasoline presents some unique firefighting challenges. Traditional methods of firefighting against hydrocarbon (gasoline) fires have been found to be ineffective against these polar solvent-type (ethanol-blended) fuels. While gasoline will tend to float on top of water, ethanol fuels are water soluble and will tend to blend with the water. For this reason, the use of Alcohol-Resistant Aqueous Film-Foaming Foam (AR-AFFF) as a means of extinguishing an ethanol fire is recommended.
Since the beginning of the twentieth century, the United States and the world have become a motorized society. Most families either own an automobile or rely on motorized transportation on a daily basis. For the past 100 years, the primary automotive fuel has been a byproduct of crude oil, a limited natural resource. Opposite from the European community, who focused on diesel engines for light-duty and passenger vehicles, the United States automobile industry, has predominantly produced gasoline-powered vehicles. The heavy-duty or off-road larger vehicles and equipment are generally being powered by diesel. Both gasoline and diesel are hydrocarbons (composed of hydrogen and carbon) derived from crude oil.

The nature and characteristics of hydrocarbon fuels are familiar to virtually everyone involved in fire protection today since gasoline and diesel are so widely used and incidents are common occurrences. However, as a result of public policy toward foreign oil supplies and other mandates, ethanol-blended fuels are becoming a substantial component of the U.S. motor fuel market. Today, ethanol is blended into 98 percent of the nation’s gasoline and is sold virtually from coast-to-coast and border-to-border. The bio-fuels industry, in general, is expected to significantly contribute to the nation’s motor fuel supply. The ethanol industry has grown rapidly. Consumers in the United States use more than 140 billion gallons of gasoline per year, and already most of that is blended with ethanol. This course will address the needs of emergency responders when faced with incidents involving ethanol and ethanol-blended fuels.

On December 19, 2007, the Energy Independence and Security Act of 2007 was signed into law. This comprehensive energy legislation amends the Renewable Fuels Standard (RFS) signed into law in 2005, growing the RFS to 36 billion gallons in 2022. By doing so, the legislation seizes on the potential that renewable fuels offer to reduce foreign oil dependence and greenhouse gas emissions and provide meaningful economic opportunity across this country, putting America firmly on a path toward greater energy stability and sustainability.
**History of Ethanol-Blended Fuels**

Ethanol has been a gasoline additive since the late 1970s. As of 2012, the United States fuel-grade ethanol production capacity has grown to over 13 billion gallons. Until the late 1980s ethanol’s primary role in the fuels market was that of an octane enhancer, and it was viewed as an environmentally sound alternative to the use of lead in gasoline. With its 112.5 blending octane value, ethanol remains an effective octane enhancer for the refiner or fuel blender. In the late 1980s some states began to use ethanol and other oxygenates in mandatory oxygenated fuel programs to reduce automobile tailpipe emissions of carbon monoxide (CO). Fuel oxygenates, such as ethanol, add chemical oxygen to the fuel, which promotes more complete combustion thereby lowering CO emissions. Hydrocarbon exhaust emissions are also often reduced. Today, ethanol is the most widely used oxygenate for reformulated gasoline (RFG). This is largely due to the fact that use of the other oxygenate in the program, methyl tertiary butyl ether (MTBE), has been banned in nearly all states. The path to E15 (15% ethanol, 85% gasoline) began in March 2009. In January 2011, the U.S. EPA approved the use of E15 fuel in light duty cars, trucks and SUVs model year 2001 and newer and for use in all FFVs. Vehicles older than 2001, small engines, boats and motorcycles were not approved for E15 fuel use.

**Common Ethanol-Blended Fuel**

Ethanol-blended fuels may include blends of gasoline and ethanol in any ratio, but at present there are three common ethanol-blended fuels. Most common is E10, a 90 percent gasoline/10 percent ethanol blend, which may be labeled as RFG or oxygenated gasoline. Also common is E98/E95 (denatured fuel ethanol) ethanol that has been denatured with 2-5 percent unleaded gasoline. This blend is known as either fuel-grade ethanol or denatured fuel ethanol and is one of the top freight rail commodities in the United States. Finally, E85 (85 percent fuel ethanol and 15 percent gasoline) is sold into a developing market as a retail blend for flexible-fuel vehicles (FFV) only. With a requirement to replace the octane improvement lost by state bans on MTBE, the demand for ethanol has increased dramatically.

**Summary**

**Instructor Note:**

Ask the participants:

- With ethanol-blended fuel use increasing, you can expect to encounter them just about anywhere. What aspect of the use of ethanol-blended fuels might have the most impact on your private life or professional career (i.e., increased production, spill and fire risk, price at the pump, vehicle efficiency, etc.)?

- What additional alternative fuels besides ethanol and other bio-fuels are being considered to supply energy to the United States consumer (e.g., hydroelectric, wind, solar, nuclear, etc.)?

Ethanol has been in use since the early 1970s. However, it has been since the year 2000 that we have seen its use expand dramatically in the United States, largely due to demands for cleaner air combined with state bans on MTBE. The ethanol industry is meeting current consumption needs of the industry.