

Automotive Technology 6th Edition

Chapter 69 ALTERNATIVE FUELS

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This Automotive Technology 6th text provides complete coverage of automotive components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and ASE Education (NATEF) and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Case Studies, Videos, Animations, and ASE Education (NATEF) Task Sheets.
Motivate Learners	Explain how the knowledge of how something works translates into the ability to use that knowledge to figure why the engine does not work correctly and how this saves diagnosis time, which translates into more money.
State the learning objectives for the chapter or course you are about to cover and explain this is what they should be able to do as a result of attending this session or class.	Explain learning objectives to students as listed below: <ol style="list-style-type: none">1. List alternatives to gasoline.2. Discuss how alternative fuels affect driveability.3. Explain how alternative fuels can reduce CO exhaust emissions.4. Discuss safety precautions when working with alternative fuels.
Establish the Mood or Climate	Provide a WELCOME , Avoid put downs and bad jokes.
Complete Essentials	Restrooms, breaks, registration, tests, etc.
Clarify and Establish Knowledge Base	Do a round robin of the class by going around the room and having each student give their backgrounds, years of experience, family, hobbies, career goals, or anything they want to share.

NOTE: Lesson plan is based on 6th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

DOWNLOAD Chapter 69 Chapter Images: From http://www.jameshalderman.com/automotive_principles.html

NOTE: You can use Chapter Images or possibly Power Point files:

ICONS	Chapter 69 Alternative Fuels
	<p>1. SLIDE 1 Chapter 69 ALTERNATIVE FUELS</p> <p>2. SLIDE 2 EXPLAIN Figure 69-1 ethanol molecule showing 2 carbon atoms, 6 hydrogen atoms, & 1 O₂ atom</p> <p>Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE IS CONSTANTLY UPDATED</p> <p>http://www.jameshalderman.com/automotive_principles.html</p> <p>DOWNLOAD</p> <p>Crossword Puzzle (Microsoft Word) (PDF)</p> <p>Word Search Puzzle (Microsoft Word) (PDF)</p> <p><u>Videos</u></p> <p>DISCUSSION: Have the students discuss ethanol and how it is produced. Since ethanol produced for fuel is the same as that found in alcoholic drinks, can drink manufacturers produce fuel for vehicles?</p> <p>SAFETY Review the meaning of <u>denatured</u>. Remind the students that when fuel becomes denatured, it is unfit for human consumption.</p> <p>DISCUSSION: Have the students talk about cellulose biomass? How are the greenhouse effects of combustion of biomass offset?</p> <p>DISCUSS FREQUENTLY ASKED QUESTION: <i>Does Ethanol Production Harm Environment?</i> The production of ethanol is considered carbon neutral because amount of CO₂ released during production is equal to amount of CO₂ that is released if the corn or other products were left to decay.</p> <p>3. SLIDE 3 EXPLAIN Figure 69-2 Some retail stations offer a variety of fuel choices, such as this station in Ohio where E10 and E85 are available.</p>

ICONS

Chapter 69 Alternative Fuels



DISCUSS FREQUENTLY ASKED QUESTION:

What Is Switchgrass? Switchgrass (*Panicum virgatum*) can be used to make ethanol and is a summer perennial grass that is native to North America. It is a natural component of tall-grass prairie, which covered most of Great Plains, but was also found on the prairie soils in Black Belt of Alabama and Mississippi. Switchgrass is resistant to many pests and plant diseases, and is capable of producing high yields with very low applications of fertilizer. This means that the need for agricultural chemicals to grow switchgrass is relatively low. Switchgrass is also very tolerant of poor soils, flooding, and drought, which are widespread agricultural problems in the southeast. There are two main types of switchgrass:

- Upland types—usually grow five to six feet tall
- Lowland types—grow up to 12 feet tall and are typically found on heavy soils in bottomland sites Better energy efficiency is gained because less energy is used to produce ethanol from switchgrass.

DISCUSSION: Have students talk about **E85** and its effects on fuel economy. Is it worth using **E85** since you have to purchase more **E85** than regular gas for the same mileage? What is price difference between regular gas & **E85**? **FIGURE 69-2**

4. **SLIDE 5 EXPLAIN** Figure 69-3 location of sensor can vary, depending on make & model of vehicle, but it is always in fuel line between tank & injectors.
5. **SLIDE 5 EXPLAIN** Figure 69-4 cutaway view of a typical variable fuel sensor.



ICONS	Chapter 69 Alternative Fuels
	<p><u>DEMONSTRATION:</u> Show students location of variable fuel sensor. Review its function with the students: <u>FIGURES 69-3 & 4</u></p>
	<p><u>DISCUSSION:</u> discuss fuel compensation. Compare use of <u>fuel compensation sensor</u> and oxygen sensor for a flex-fuel system. Why should a technician avoid resetting fuel compensation?</p>
	<p>6. SLIDE 6 <u>EXPLAIN</u> FIGURE 69-5 warning sticker on an E85 pump warning to only use this fuel in vehicles designated as flexible fuel vehicles (FFV).</p>
	<p><u>DISCUSSION:</u> Have the students discuss <u>E85</u> fuel system requirements. What additional hardware is on <u>E85</u> vehicles? <u>FIGURE 69-5</u></p>
	<p>7. SLIDE 7 <u>EXPLAIN</u> Figure 69-6 flex-fuel vehicle often has a yellow gas cap, which is labeled E85/gasoline.</p>
	<p><u>DISCUSSION:</u> Have the students talk about enhanced fuel system <u>components & materials</u> used for flex-fuel vehicles. Can ethanol damage common fuel pumps? What will happen to O-rings that are not alcohol-resistant?</p>
	<p><u>DEMONSTRATION:</u> Use a <u>Flex-Fuel Vehicle</u> to show students identifiers that place it in <u>E85</u> class. Talk about emissions produced by ethanol fueled vehicles.</p>
	<p><u>HANDS-ON TASK:</u> Have students locate <u>VECI</u> on <u>Flex-Fuel Vehicles</u> you have in your shop. Have students share locations & information found:</p>
	<p><u>FIGURE 69-6.</u> Have students identify special features on E85 vehicle & explain why vehicle is identified as flex-fuel.</p>
	<p><u>EXPLAIN TECH TIP:</u> <i>Purchase a Flex-Fuel Vehicle</i> If purchasing a new or used vehicle, try to find a flex-fuel vehicle. Even though you may not want to use E85, a flex-fuel vehicle has a more robust fuel system than a conventional fuel system designed for gasoline or E10. The enhanced fuel system components and materials usually include:</p>

ICONS	Chapter 69 Alternative Fuels
	<ul style="list-style-type: none"> • Stainless steel fuel rail • Graphite commutator bars instead of copper in fuel pump motor (ethanol can oxidize into acetic acid, which can corrode copper) • Diamond-like carbon (DLC) corrosion-resistant fuel injectors • Alcohol-resistant O-rings and hoses • Cost of a flex-fuel vehicle compared with same vehicle designed to operate on gasoline is a no-cost or a low-cost option. <p>DISCUSS FREQUENTLY ASKED QUESTION: <i>How Does a Sensorless Flex-Fuel System Work?</i> Many flex-fuel vehicles do not use a fuel compensation sensor and instead use the oxygen sensor to detect the presence of lean mixture and the extra oxygen in the fuel. Powertrain Control Module (PCM) then adjusts injector pulse-width and the ignition timing to optimize engine operation to the use of E85. This type of vehicle is called a virtual flexible fuel vehicle (V-FFV). The virtual flexible fuel vehicle can operate on pure gasoline or blends up to 85% ethanol.</p>
	<p>DISCUSS FREQUENTLY ASKED QUESTION: <i>How Long Can Oxygenated Fuel Be Stored Before All of the Oxygen Escapes?</i> The oxygen in oxygenated fuels, such as E10 and E85, is not in a gaseous state like the CO₂ in soft drinks. The oxygen is part of the molecule of ethanol or other oxygenates and does not bubble out of the fuel. <i>Oxygenated fuels, just like any fuel, have a shelf life of about 90 days.</i></p>
	<p>8. SLIDE 8 EXPLAIN Figure 69-7 A vehicle emission control information (VECI) sticker on a flexible fuel vehicle indicating that it can use ethanol from 0 to 85%.</p>

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	<p>HANDS-ON TASK: Have students diagnose a vehicle with an O₂ code present. Help them use a SCAN TOOL, DMM, & 5-Gas analyzer, as needed, for their diagnoses.</p>
	<p>9. SLIDE 9 EXPLAIN Figure 69-8 The molecular structure of methanol showing the one carbon atom, four hydrogen atoms, and one oxygen atom.</p>
	<p>10. SLIDE 10 EXPLAIN Figure 69-9 Sign on methanol pump shows that methyl alcohol is a poison and can cause skin irritation and other personal injury. Methanol is used in industry as well as being a fuel</p>
	<p>SAFETY Review with students PPE that should be used when handling methanol. Talk about ventilation procedures when working with methanol vehicles, including where exhaust fans should be placed, opening bay doors, monitoring running vehicles in shop, etc. FIGURE 69-9</p>
	<p>DISCUSSION: Have the students talk about methanol and its production. What is biggest source of methanol in United States? What is M85?</p>
	<p>11. SLIDE 11 EXPLAIN Figure 69-10 Propane fuel storage tank in trunk of Ford taxi.</p>
	<p>DISCUSSION: Have the students talk about propane. How does propane's use compare to that of other fuels? Why is propane less economical to use than other fuels? FIGURE 69-10</p>
	<p>12. SLIDE 12 EXPLAIN Figure 69-11 The blue sticker on the rear of this vehicle indicates that it is designed to use compressed natural gas.</p>
	<p>13. SLIDE 13 EXPLAIN Figure 69-12 A CNG storage tank from a Honda Civic GX shown with the fixture used to support it while it is being removed or installed in the vehicle. Honda specifies that three technicians be used to remove or install the tank through the rear door of the vehicle due to the size and weight of the tank.</p>
	<p>DISCUSSION: Have students talk about compressed natural gas. Why is natural gas odorized during production? FIGURE 69-11 & 12</p>

ICONS	Chapter 69 Alternative Fuels
	<p>14. SLIDE 14 EXPLAIN Figure 69-13 fuel injectors used on this Honda Civic GX CNG engine are designed to flow gaseous fuel instead of liquid fuel and cannot be interchanged with any other type of injector.</p>
	<p>DISCUSSION: Have the students discuss differences between using gasoline and CNG in vehicles. What design differences are required for a CNG engine? FIGURE 69-13</p>
	<p>15. SLIDE 15 EXPLAIN Figure 69-14 This CNG pump is capable of supplying compressed natural gas at either 3,000 PSI or 3,600 PSI. The price per gallon is higher for the higher pressure.</p>
	<p>DISCUSS FREQUENTLY ASKED QUESTION: <i>What Is the Amount of CNG Equal to in Gasoline?</i> To achieve amount of energy of one gallon of gasoline, 122 cubic feet of compressed natural gas (CNG) is needed. While octane rating of CNG is much higher than gasoline (130 octane), using CNG instead of gasoline in same engine results in a reduction 10% to 20% of power due to lower heat energy that is released when CNG is burned in engine.</p>
	<p>DISCUSS CHART 69-1 characteristics of alternative fuels compared to regular unleaded gasoline shows that all have advantages and disadvantages</p>
	<p>DISCUSSION: Have the students discuss CNG fuel systems. What is importance of having lock-off valves in CNG vehicles?</p>
	<p>DISCUSSION: Discuss refueling of CNG vehicles. Why is it important to fill a CNG vehicle's tank slowly?</p>
	<p>DISCUSSION: Have the students talk about liquefied natural gas. What are practicalities of using LNG in vehicles?</p>

ICONS	Chapter 69 Alternative Fuels
	<p>DISCUSSION: Have the students talk about tri-fuel vehicles. Which fuels are <u>tri-fuel vehicles</u> capable of using?</p>
	<p>DISCUSSION: Have students use <u>Chart 69–2</u> to review the advantages & disadvantages of alternative fuels. Which have fossil fuel sources?</p>
	<p>16. SLIDE 16 EXPLAIN Figure 69-15 A Fischer-Tropsch processing plant is able to produce a variety of fuels from coal.</p>
	<p>DISCUSSION: discuss <u>Fischer-Tropsch method</u>. What is biggest drawback to Fischer-Tropsch fuels? <u>FIGURE 69-15</u></p>
	<p>DISCUSSION: Have the students discuss future of <u>synthetic fuels</u>. How is rising cost of crude oil affecting the cost effectiveness of alternative methods of producing fuels?</p>
	<p>SAFETY When working on fuel systems, equipment that can create a spark/flame should be removed from area. Students review their shop area & address which items should be removed for working on fuel systems.</p>
	<p>WARNING: Do not smoke or have an open flame in the area when working around or refueling any vehicle.</p>
	<p>Fuel Mileage, Electric (View) (Download) Fuel Mileage, EREV (View) (Download)</p>
	<p>ON-VEHICLE ASE EDUCATION TASK <u>Alternative Fuel</u> Meets <u>ASE EDUCATION</u> Task: Not specified by <u>ASE EDUCATION</u></p>
	