

# Automotive Fuel and Emissions Control Systems 4/E


## Chapter 6 Alternative Fuels











### Opening Your Class

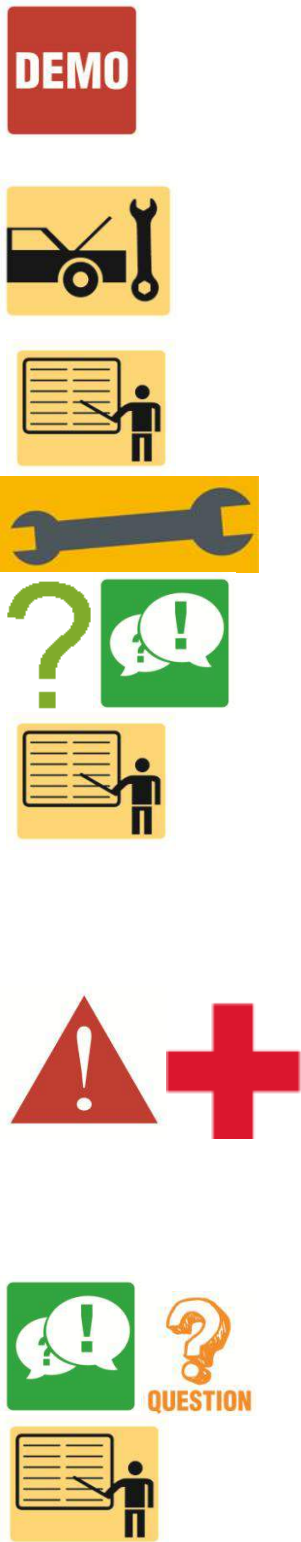
KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers operation and service of <b>Automotive Fuel and Emissions Control Systems</b> . It correlates material to task lists specified by ASE and NATEF.
Motivate Learners	Explain how the knowledge of how something works translates into the ability 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 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 the chapter learning objectives to the students. 1. Discuss the alternatives to gasoline. 2. Understand how alternative fuels affect driveability. 3. Explain how alternative fuels reduce CO exhaust emissions. 4. List the safety precautions to be taken when working with alternative fuels.
Establish the Mood or Climate	Provide a <i>WELCOME</i> , 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: This lesson plan is based on Fuel & Emission Control 4<sup>th</sup> Edition Chapter Images found on Jim's web site @ [www.jameshalderman.com](http://www.jameshalderman.com)**

**LINK CHP 6: [Chapter Images](#)**

ICONS	Ch06 ALTERNATIVE FUELS
	<p><b>1. SLIDE 1 CH6 ALTERNATIVE FUELS</b></p> <p>Check for <b>ADDITIONAL VIDEOS &amp; ANIMATIONS</b>  @ <a href="http://www.jameshalderman.com/">http://www.jameshalderman.com/</a>  <b>WEB SITE REGULARLY UPDATED</b></p> <p><b><u>Videos</u></b></p> <p><b><u>Fuel Mileage, Electric (View) (Download)</u></b>  <b><u>Fuel Mileage, EREV (View) (Download)</u></b></p> <p><b>At the beginning of this class, you can download the crossword puzzle &amp; Word Search from the links below to familiarize your class with the terms in this chapter &amp; then discuss them</b></p> <p><b><u>Crossword Puzzle (Microsoft Word) (PDF)</u></b>  <b><u>Word Search Puzzle (Microsoft Word) (PDF)</u></b></p> <p><b>2. SLIDE 2 EXPLAIN FIGURE 6–1 ethanol molecule showing 2 carbon atoms, 6 hydrogen atoms, &amp; one oxygen atom</b></p> <p><b><u>DISCUSSION:</u> 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?</b></p> <p><b><u>DISCUSSION:</u> HAVE THE STUDENTS TALK ABOUT CELLULOSE BIOMASS? HOW ARE THE GREENHOUSE EFFECTS OF COMBUSTION OF BIOMASS OFFSET?</b></p> <p><b>DISCUSS FREQUENTLY ASKED QUESTION</b></p>

ICONS	Ch06 ALTERNATIVE FUELS
 	<p>3. SLIDE 3 EXPLAIN E85 &amp; EXPLAIN Figure 6-2 Some retail stations offer a variety of fuel choices, such as this station in Ohio where E10 and E85 are available</p> <p><b>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 &amp; E85? FIGURE 6-2</b></p>
	<p>4. SLIDE 4 EXPLAIN Figure 6-3 location of sensor can vary, depending on make &amp; model of vehicle, but it is always in fuel line between tank &amp; injectors.</p> <p>5. SLIDE 5 EXPLAIN Figure 6-4 cutaway view of a typical variable fuel sensor.</p>
	<p><b>DEMONSTRATION: SHOW STUDENTS LOCATION OF VARIABLE FUEL SENSOR. REVIEW ITS FUNCTION WITH STUDENTS</b></p>
	<p>EXPLAIN TECH-TIP</p>
	<p>DISCUSS FREQUENTLY ASKED QUESTION</p>
	<p><b>DISCUSSION: DISCUSS FUEL COMPENSATION. COMPARE USE OF FUEL COMPENSATION SENSOR AND OXYGEN SENSOR FOR A FLEX-FUEL SYSTEM. WHY SHOULD A TECHNICIAN AVOID RESETTNG FUEL COMPENSATION?</b></p>
	<p><b>DISCUSSION: DISCUSS E85 FUEL SYSTEM REQUIREMENTS. WHAT ADDITIONAL HARDWARE IS ON E85 VEHICLES?</b></p>
	<p>6. SLIDE 6 EXPLAIN FIGURE 6-5 pump for E85 (85% ethanol &amp; 15% gasoline). E85 is available in more locations every year</p>
	<p>7. SLIDE 7 EXPLAIN Figure 6-6 flex-fuel vehicle often has a yellow gas cap, which is labeled E85/gasoline.</p> <p><b>DISCUSSION: DISCUSS ENHANCED FUEL SYSTEM COMPONENTS &amp; MATERIALS USED FOR FLEX-FUEL VEHICLES. CAN ETHANOL DAMAGE COMMON</b></p>

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	<p><b>FUEL PUMPS? WHAT WILL HAPPEN TO O-RINGS THAT ARE NOT ALCOHOL-RESISTANT?</b></p> <p><b><u>DEMONSTRATION: USE A FLEX-FUEL VEHICLE TO SHOW STUDENTS IDENTIFIERS THAT PLACE IT IN E85 CLASS. TALK ABOUT EMISSIONS PRODUCED BY ETHANOL FUELED VEHICLES.</u></b></p> <p><b><u>HANDS-ON TASK: HAVE STUDENTS LOCATE VECI ON FLEX-FUEL VEHICLES YOU HAVE IN YOUR SHOP. HAVE STUDENTS SHARE LOCATIONS &amp; INFORMATION FOUND</u></b></p> <p>8. SLIDE 8 EXPLAIN Figure 6-7 vehicle emission control information (VECI) sticker on a flexible fuel vehicle indicating that it can use ethanol from 0 to 85%.</p> <p><b>EXPLAIN TECH-TIP</b></p> <p><b>DISCUSS FREQUENTLY ASKED QUESTION</b></p> <p>9. SLIDE 9 EXPLAIN METHANOL &amp; Figure 6-8 molecular structure of methanol showing the one carbon atom, four hydrogen atoms, and one oxygen atom.</p> <p>10. SLIDE 10 EXPLAIN Figure 6-9 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><b><u>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 DOORS, MONITORING RUNNING VEHICLES, ETC.</u></b></p> <p><b><u>DISCUSSION: DISCUSS METHANOL AND ITS PRODUCTION. WHAT IS BIGGEST SOURCE OF METHANOL IN UNITED STATES? WHAT IS M85?</u></b></p> <p>11. SLIDE 11 EXPLAIN Figure 6-10 Propane fuel storage tank in trunk of Ford taxi.</p>

**ICONS****Ch06 ALTERNATIVE FUELS**

**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 6-26**

12. **SLIDE 21 EXPLAIN COMPRESSED NATURAL GAS & EXPLAIN Figure 6-11** The blue sticker on the rear of this vehicle indicates that it is designed to use compressed natural gas.
13. **SLIDE 13 EXPLAIN Figure 6-12** 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.

**DISCUSSION: HAVE STUDENTS TALK ABOUT COMPRESSED NATURAL GAS. WHY IS NATURAL GAS ODORIZED DURING PRODUCTION?**














14. **SLIDE 14 EXPLAIN Figure 6-13** 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.
15. **SLIDE 15 EXPLAIN Figure 6-14** This CNG pump is capable of supplying compressed natural gas at either 3,000 PSI or 3,600 PSI. Price per gallon is higher for the higher pressure.

**DISCUSS FREQUENTLY ASKED QUESTION**

**DISCUSSION: HAVE THE STUDENTS DISCUSS DIFFERENCES BETWEEN USING GASOLINE AND CNG IN VEHICLES. WHAT DESIGN DIFFERENCES ARE REQUIRED FOR A CNG ENGINE?**

**DISCUSSION: HAVE THE STUDENTS DISCUSS CNG FUEL SYSTEMS. WHAT IS IMPORTANCE OF HAVING LOCK-OFF VALVES IN CNG VEHICLES?**

**DISCUSSION: DISCUSS REFUELING OF CNG VEHICLES. WHY IS IT IMPORTANT TO FILL A CNG VEHICLE'S TANK SLOWLY?**

ICONS	Ch06 ALTERNATIVE FUELS
  <p>QUESTION</p>	<p><b><u>DISCUSSION:</u> HAVE THE STUDENTS TALK ABOUT <u>LIQUEFIED NATURAL GAS</u>. WHAT ARE PRACTICALITIES OF USING LNG IN VEHICLES?</b></p>
  <p>QUESTION</p>	<p><b><u>DISCUSSION:</u> HAVE THE STUDENTS TALK ABOUT TRI-FUEL VEHICLES. WHICH FUELS ARE <u>TRI-FUEL VEHICLES</u> CAPABLE OF USING?</b></p>
  <p>QUESTION</p>	<p><b><u>DISCUSSION:</u> USE <u>CHART 6-3</u> TO REVIEW THE ADVANTAGES &amp; DISADVANTAGES OF ALTERNATIVE FUELS. WHICH HAVE FOSSIL FUEL SOURCES?</b></p>
	<p><b>16. SLIDE 16 EXPLAIN</b> Figure 6-15 Fischer-Tropsch processing plant able to produce a variety of fuels from coal</p>
  <p>QUESTION</p>	<p><b><u>DISCUSSION:</u> DISCUSS <u>FISCHER-TROPSCH METHOD</u>. WHAT IS BIGGEST DRAWBACK TO FISCHER-TROPSCH FUELS? <u>FIGURE 6-15</u></b></p>
 	<p><b>EXPLAIN WARNING</b></p>
  <p>QUESTION</p>	<p><b><u>DISCUSSION:</u> DISCUSS FUTURE OF <u>SYNTHETIC FUELS</u>. HOW IS RISING COST OF CRUDE OIL AFFECTING THE COST EFFECTIVENESS OF ALTERNATIVE METHODS OF PRODUCING FUELS?</b></p>