

# Hybrids & Alternative Fuel Vehicles 4/E

## Chapter 2 Introduction to Hybrid Vehicles

### Opening Your Class









<b>KEY ELEMENT</b>	<b>EXAMPLES</b>
<b>Introduce Content</b>	This course or class covers operation and service of <a href="#">Hybrid and Alternative Fueled Vehicles</a> . It correlates material to task lists specified by ASE and NATEF.
<b>Motivate Learners</b>	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.
<b>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.</b>	Explain the chapter learning objectives to the students. <ol style="list-style-type: none"><li>1. Describe the different types of hybrid electric vehicles.</li><li>2. Explain how a hybrid vehicle is able to achieve an improvement in fuel economy compared to a conventional vehicle design.</li><li>3. Discuss the advantages and disadvantages of the various hybrid designs.</li><li>4. Describe HEV components, including motors, energy sources, and motor controllers.</li><li>5. Discuss the operation of a typical hybrid electric vehicle</li></ol>
<b>Establish the Mood or Climate</b>	Provide a <i>WELCOME</i> , Avoid put downs and bad jokes.
<b>Complete Essentials</b>	Restrooms, breaks, registration, tests, etc.
<b>Clarify and Establish Knowledge Base</b>	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 Hybrids 4<sup>th</sup> Edition**












**Chapter Images found on Jim's web site @**









**[www.jameshalderman.com](http://www.jameshalderman.com)**











**LINK CHP 2: [Chapter Images](#)**

ICONS	Ch02 Introduction to Hybrid Vehicles
	<p><b>1. SLIDE 1 CH2 INTRO TO HEVS</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 IS CONSTANTLY UPDATED</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>2. SLIDE 2 EXPLAIN Figure 2-1</b> View of components of GM electric vehicle (EV1). Many of features of this vehicle, such as regenerative braking, currently used on hybrid vehicles were first USED on this vehicle</p>
	<p><b><u>DISCUSSION:</u> ASK THE STUDENTS TO DISCUSS EVOLUTION OF AUTOMOBILES. HAVE THEM SHARE HOW AUTOMOBILES HAVE CHANGED OVER TIME. WHAT ADVANCES WILL FUTURE VEHICLES HAVE?</b></p>
	<p><b><u>DISCUSSION:</u> REVIEW WITH STUDENTS DIFFERENT METHODS OF PROPULSION. WHAT TWO COMMON COMBINATIONS ARE BEING USED TO CLASSIFY VEHICLES AS HYBRIDS?</b></p>
	<p><b><u>DISCUSSION:</u> REVIEW OHM'S LAW: 1 VOLT IS REQUIRED TO PUSH 1 AMPERE THROUGH 1 OHM OF RESISTANCE; IF VOLTAGE IS DOUBLED, THEN NUMBER OF AMPERES OF CURRENT FLOWING THROUGH CIRCUIT WILL ALSO DOUBLE IF RESISTANCE OF CIRCUIT REMAINS SAME. HOW DOES OHM'S LAW APPLY TO ELECTRIC VEHICLES?</b></p>
	<p><b><u>SAFETY</u> REMIND STUDENTS TO USE INSULATED TOOLS WHEN WORKING ON VEHICLES THAT USE HIGH VOLTAGE.</b></p>
	<p><b><u>DISCUSSION:</u> GATHER INFORMATION ABOUT NEWEST ZEV (ZERO EMISSION) VEHICLES AVAILABLE. ASK STUDENTS TO IDENTIFY CURRENT BENEFITS, PROBLEMS, &amp; FUTURE OF ZEVS</b></p>

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	<p><b>DISCUSSION: HAVE THE STUDENTS CONSIDER THE BENEFITS OR DRAWBACKS CONCERNING COST OF A VEHICLE VS. FUEL SAVINGS. HOW LONG WILL YOU NEED TO DRIVE A VEHICLE WITH FUEL SAVINGS IN ORDER TO OFFSET ITS EXTRA COST AS COMPARED TO DRIVING AN INTERNAL COMBUSTION ENGINE VEHICLE?</b></p>
	<p><b>DEMONSTRATION: MEASURE <u>AMPERAGE &amp; VOLTAGE IN SERIES AND PARALLEL CIRCUITS</u> ON VEHICLE, OR <u>TRAINER</u>. CALL ATTENTION TO THE CHANGE IN AMPERES AND VOLTS BETWEEN SERIES AND PARALLEL CIRCUITS.</b></p>
	<p>3. SLIDE 3 <b>EXPLAIN</b> Figure 2-2 Chevrolet Volt is charged through a port located at the left front.</p>
	<p><b>DEMONSTRATION: <u>START HYBRID VEHICLE WITH STUDENTS. HAVE THEM COMPARE &amp; CONTRAST THIS START WITH A COMBUSTION ENGINE VEHICLE START. ASK STUDENTS TO DISCUSS DIFFERENCES BETWEEN 2 STARTS.</u></b></p>
	<p><b>DISCUSSION: SHOW THE CHARGE PORT FOR A HYBRID ELECTRIC VEHICLE. DISCUSS THE PROCEDURES INVOLVED WITH RECHARGING ALONG WITH ELECTRICAL REQUIREMENTS OF A CHARGING FACILITY. <u>FIGURE 2-2</u></b></p>
	<p>4. SLIDE 4 <b>EXPLAIN</b> Figure 2-3 drawing of power flow in a typical series-hybrid vehicle.</p> <p>5. SLIDE 5 <b>EXPLAIN</b> Figure 2-4 diagram shows components included in typical series-hybrid design. Solid-line arrow indicates transmission of torque to drive wheels. Dotted-line arrow indicate electrical current flow</p>
	<p><b>DISCUSS FREQUENTLY ASKED QUESTION</b></p> <p><b>ANIMATION: <u>SERIES HEV OPERATION</u></b>  <b><u>WWW.MYAUTOMOTIVELAB.COM</u></b>  <a href="http://media.pearsoncmg.com/ph/chet/chet_myLABS/akamai/template/video640x480.php?title=comprehensive%20components&amp;clip=pandc/chet/2012/automotive/obd2_getting_on_board/clip1.mov&amp;caption=chet/chet_myLABS/akamai/2012/automotive/obd2_getting_on_board/xml/clip1.xml">HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYLABS/AKAMAI/TEMPLATE/VIDEO640X480.PHP?TITLE=COMPREHENSIVE%20COMPONENTS&amp;CLIP=PANDC/CHET/2012/AUTOMOTIVE/OBD2_GETTING_ON_BOARD/CLIP1.MOV&amp;CAPTION=CHET/CHET_MYLABS/AKAMAI/2012/AUTOMOTIVE/OBD2_GETTING_ON_BOARD/XML/CLIP1.XML</a></p>

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	<p>6. SLIDE 6 <b>EXPLAIN</b> Figure 2-5 power flow in a typical parallel-hybrid vehicle.</p>
	<p>7. SLIDE 7 <b>EXPLAIN</b> Figure 2-6 Diagram showing components involved in a typical parallel-hybrid vehicle. The solid-line arrows indicate the transmission of torque to the drive wheels, and the dotted-line arrows indicate the flow of electrical current</p>
	<p><b>ANIMATION: <u>PARALLEL HEV OPERATION</u></b>  <b><u>WWW.MYAUTOMOTIVELAB.COM</u></b>  <a href="http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/ax_animations/chapter64_fig_64_5/index.htm">HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYAUTOMOTIVELAB_2/ANIMATIONS/AX_ANIMA  TIONS/CHAPTER64 FIG 64 5/INDEX.HTM</a></p>
	<p><b>DISCUSS FREQUENTLY ASKED QUESTION</b></p>
	<p>8. SLIDE 8 <b>EXPLAIN</b> Figure 2-7 series-parallel hybrid design allows vehicle to operate in electric motor mode only or in combination with internal combustion engine.</p>
	<p><b>ANIMATION: <u>SERIES-PARALLEL HEV OP.</u></b>  <b><u>WWW.MYAUTOMOTIVELAB.COM</u></b>  <a href="http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/ax_animations/chapter64_fig_64_7/index.htm">HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYAUTOMOTIVELAB_2/ANIMATIONS/AX_ANIMA  TIONS/CHAPTER64 FIG 64 7/INDEX.HTM</a></p>
 <p>QUESTION</p>	<p><b>DISCUSSION: COMPARE &amp; CONTRAST COMPONENTS OF SERIES &amp; PARALLEL HYBRID VEHICLES, REFERRING TO <u>FIGURES 2-3 TO 2-7.</u></b></p>
 <p>QUESTION</p>	<p><b>ASK STUDENTS TO IDENTIFY PROS &amp; CONS</b></p>
 <p>QUESTION</p>	<p><b>DISCUSSION: HAVE STUDENTS IDENTIFY OTHER <u>FUELS</u> THAT CAN REPLACE DIESEL FUEL. HOW WILL THESE ALTERNATE FUELS HELP REDUCE FUEL COSTS?</b></p>
 <p>QUESTION</p>	<p><b>DISCUSSION: REVIEW IDLE STOP MODE WITH THE STUDENTS AND HIGHLIGHT THE DIFFERENCE BETWEEN A <u>CONVENTIONAL STARTER &amp; VOLTAGE MOTOR GENERATOR.</u></b></p>
	<p>9. SLIDE 9 <b>EXPLAIN</b> Figure 2-8 chart shows what is occurring during various driving conditions in a BAS-type hybrid.</p>

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	<p><b><u>DISCUSSION:</u> HAVE STUDENTS TALK ABOUT BELT ALTERNATOR STARTER SYSTEMS. WHAT ARE THE ADVANTAGES OF <u>BAS SYSTEMS</u>?</b>  <b><u>FIGURE 2-8</u></b></p>
	<p>10. SLIDE 10 <b><u>EXPLAIN</u></b> Figure 2-9 components of a typical belt alternator-starter (BAS) system.</p>
	<p><b><u>HANDS-ON TASK:</u> IF YOU HAVE ACCESS TO A VEHICLE WITH A BAS SYSTEM, HAVE STUDENTS IDENTIFY THE COMPONENTS OF SYSTEM, REFERRING TO <u>FIGURE 2-9</u> AS NEEDED.</b></p>
	<p><b><u>DISCUSSION:</u> DISCUSS BENEFITS &amp; DRAWBACKS OF <u>BAS SYSTEM</u>. SHOULD BAS SYSTEM BE CONSIDERED HYBRID VEHICLE? CAN BAS SYSTEM BE ADDED TO A CONVERTED DIESEL VEHICLE TO HELP IT BE CONSIDERED A FULL</b></p>
	<p><b><u>HYBRID VEHICLE? <u>FIGURE 2-9</u></u></b></p> <p><b><u>DISCUSS FREQUENTLY ASKED QUESTION</u></b></p>
	<p>11. SLIDE 24 <b><u>EXPLAIN</u></b> Figure 2-10 This sticker on a hybrid vehicle allows the driver to use the high-occupancy vehicle (HOV) lanes even if there is only one person in the vehicle as a way to increase demand for hybrid vehicles in California</p>
	<p>12. SLIDE 12 <b><u>EXPLAIN</u></b> Figure 2-11 A combination starter/alternator is used to provide idle stop function to conventional vehicles. This very limited and low cost system is called a micro-hybrid drive.</p>
	<p><b><u>DISCUSSION:</u> HOLD DISCUSSION ON <u>MICRO-HYBRID DRIVE SYSTEM:</u> WHAT IS A <u>BIDIRECTIONAL TENSIONER</u> &amp; WHAT ROLE DOES IT PLAY IN MICRO HYBRID-DRIVE SYSTEM? WHY DOES THIS BELT TENSIONER NEED TO PROVIDE TENSION IN BOTH DIRECTIONS? <u>FIGURE 2-11</u></b></p>

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 	<p><b>DISCUSS TECH TIP</b>  <b>DISCUSS FREQUENTLY ASKED QUESTION</b></p>
 	<p><b><u>DEMONSTRATION:</u> WHILE A HYBRID ENGINE IS IN IDLE STOP MODE, <u>CONNECT A 5-GAS ANALYZER.</u> HAVE STUDENTS TAKE NOTE OF CO2 READING TO CONFIRM ZERO OR LOW CO2 LEVELS IN IDLE STOP MODE. NEXT, CONNECT A 5-GAS ANALYZER TO AN ICE &amp; COMPARE CO2 READINGS AT IDLE. DISCUSS RESULTS.</b></p>
	
  <p>QUESTION</p>	<p><b><u>DISCUSSION:</u> WHAT ARE COMMON VOLTAGE RATINGS FOR MILD, MEDIUM, AND FULL HYBRID VEHICLES? <u>REMIND STUDENTS OF SAFETY PRECAUTIONS REQUIRED FOR WORKING ON HYBRID ELECTRIC VEHICLES</u></b></p>
  <p>QUESTION</p>	<p><b><u>DISCUSSION:</u> HAVE STUDENTS DISCUSS EFFICIENCIES OF ELECTRIC MOTORS &amp; IC ENGINES. WHICH IS MORE EFFICIENT OVERALL—ELECTRIC MOTOR OR ICE?</b></p>
	<p><b><u>HANDS-ON TASK:</u> HAVE THE STUDENTS RESEARCH <u>INDEPENDENT REPAIR SHOPS THAT WORK ON HYBRID ELECTRIC VEHICLES.</u> WHAT TYPES OF REPAIRS ARE THEY DOING, AND WHAT SAFETY PRECAUTIONS ARE BEING OBSERVED? HAVE STUDENTS SHARE THEIR FINDINGS WITH CLASS.</b></p>