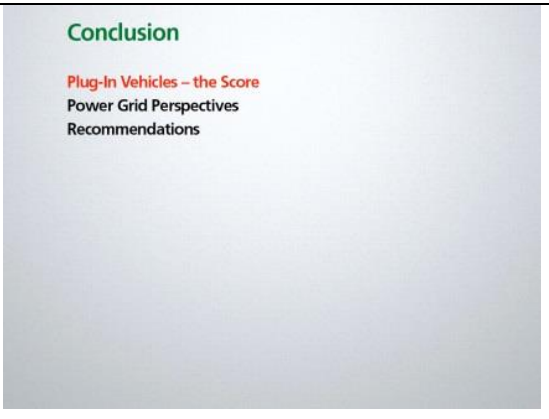
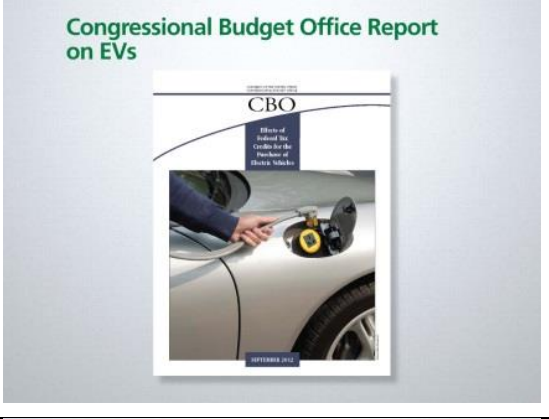
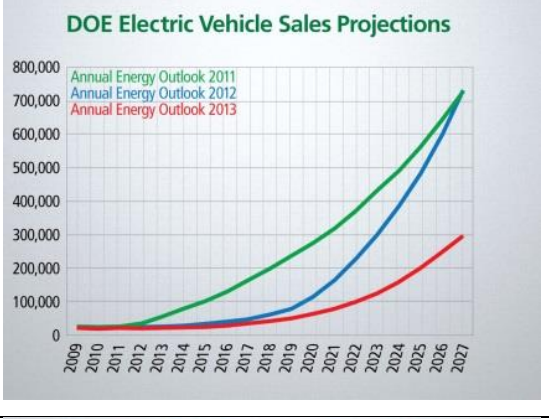
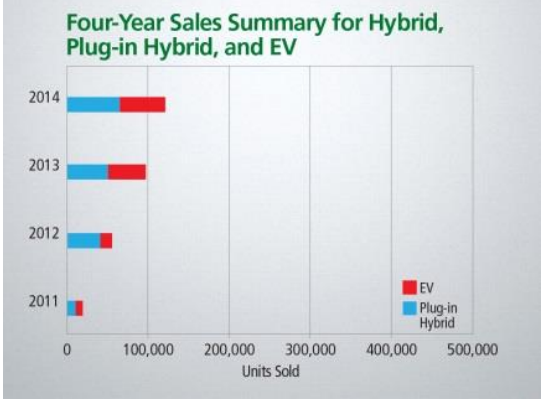





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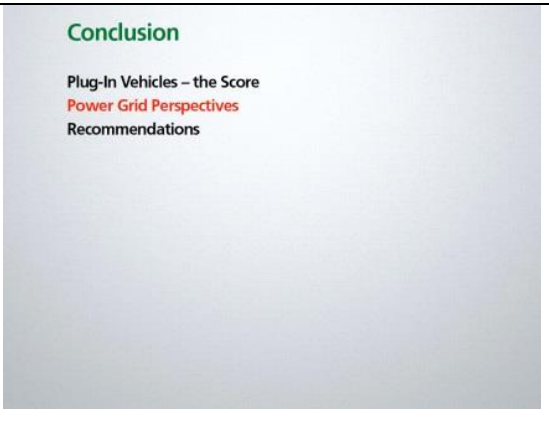
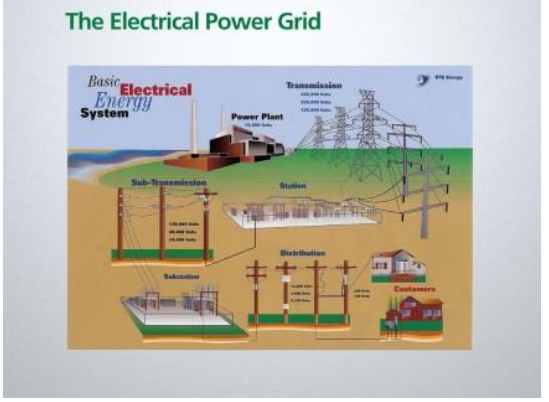
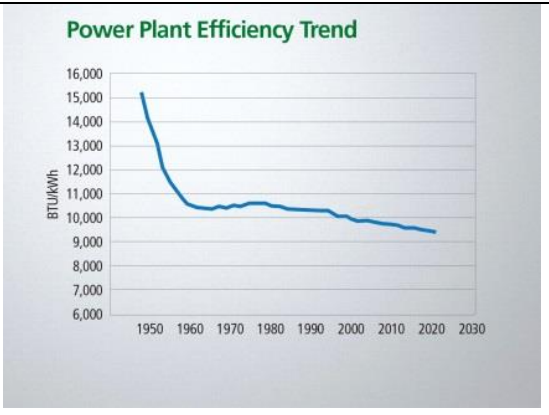
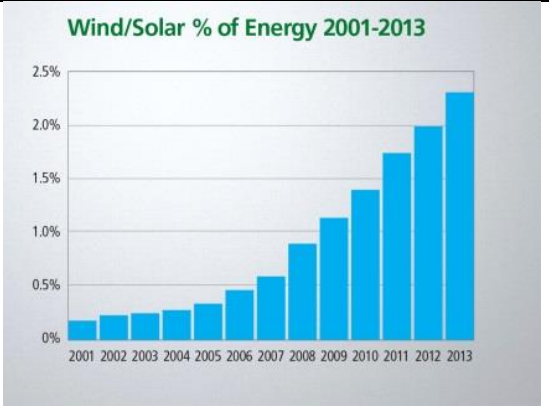
Part 5A: Conclusion – Plug-In Vehicles – the Score		
C1	<p>A 2012 Congressional Budget Office report on plug-ins says that the lifetime costs to consumers of an electric vehicle are generally higher than those of a hybrid vehicle of similar size and performance.</p>	
C2	<p>The report also noted there will be little or no reduction in the total gasoline use and greenhouse gas emissions of the nation’s vehicle fleet over the next several years.</p>	
C3	<p>After the third full year of plug-in vehicle marketing, it was obvious that sales have been far below expectations. Plug-in sales projections from the Department of Energy Annual Energy Report have shown a significant decline of future sales forecast.</p>	
C4	<p>Total plug in sales, including battery EVs and plug-in hybrids increased 200% from 2011 to 2012, 80% from 2012 to 2013, and only 25% from 2013 to 2014. The rate of increasing sales is shrinking, even with many more models available along with dramatic growth in the number of charging stations.</p>	

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<p>C5</p>	<p>Over the same time period, hybrid car sales increased 60 percent from 2011 to 2012 and 20 percent from 2012 to 2013. Hybrid cars decreased from 2013 to 2014 largely due to the delay of the next generation Prius into late 2015.</p>	<table border="1"> <caption>Four-Year Sales Summary for Hybrid, Plug-in Hybrid, and EV</caption> <thead> <tr> <th>Year</th> <th>Hybrid</th> <th>EV</th> <th>Plug-in Hybrid</th> </tr> </thead> <tbody> <tr> <td>2014</td> <td>~450,000</td> <td>~50,000</td> <td>~20,000</td> </tr> <tr> <td>2013</td> <td>~480,000</td> <td>~50,000</td> <td>~20,000</td> </tr> <tr> <td>2012</td> <td>~400,000</td> <td>~20,000</td> <td>~10,000</td> </tr> <tr> <td>2011</td> <td>~350,000</td> <td>~10,000</td> <td>~5,000</td> </tr> </tbody> </table>	Year	Hybrid	EV	Plug-in Hybrid	2014	~450,000	~50,000	~20,000	2013	~480,000	~50,000	~20,000	2012	~400,000	~20,000	~10,000	2011	~350,000	~10,000	~5,000								
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<p>C6</p>	<p>There are four main reasons for low plug-in sales. First, although plug-ins compare favorably to conventional gasoline cars in miles per gallon and CO<sub>2</sub> emissions, they do not compare favorably to hybrids such as the Prius when using well-to-wheels analysis.</p>	<table border="1"> <caption>EPA MPG/MPGe &amp; CO<sub>2</sub> Comparison</caption> <thead> <tr> <th></th> <th>2012 Prius</th> <th>2012 Volt</th> <th>2012 Leaf</th> </tr> </thead> <tbody> <tr> <td colspan="4"><b>Tank to Wheels</b></td> </tr> <tr> <td>MPG and MPGe</td> <td>50</td> <td>94</td> <td>99</td> </tr> <tr> <td>CO<sub>2</sub> (grams/mile)</td> <td>178</td> <td>87</td> <td>0</td> </tr> <tr> <td colspan="4"><b>Well to Wheels</b></td> </tr> <tr> <td>MPG and MPGe</td> <td>42</td> <td>34</td> <td>36</td> </tr> <tr> <td>CO<sub>2</sub> (grams/mile)</td> <td>250</td> <td>260</td> <td>230</td> </tr> </tbody> </table>		2012 Prius	2012 Volt	2012 Leaf	<b>Tank to Wheels</b>				MPG and MPGe	50	94	99	CO <sub>2</sub> (grams/mile)	178	87	0	<b>Well to Wheels</b>				MPG and MPGe	42	34	36	CO <sub>2</sub> (grams/mile)	250	260	230
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<p>C7</p>	<p>Second, positioning the plug-in hybrid as an improved next generation technology that would leapfrog over standard hybrids such as the Prius was a misrepresentation. Plug-in hybrids are not improvements over hybrids. They are compromised battery electric cars</p>	<table border="1"> <caption>Comparing 2003 and 2012 Prius</caption> <thead> <tr> <th></th> <th>2003 Toyota Prius</th> <th>2012 Toyota Prius</th> </tr> </thead> <tbody> <tr> <td colspan="3"><b>EPA Fuel Economy</b></td> </tr> <tr> <td></td> <td><b>41</b></td> <td><b>50</b></td> </tr> <tr> <td></td> <td>Combined</td> <td>Combined</td> </tr> <tr> <td>Miles per Gallon</td> <td>42 City, 41 Highway</td> <td>51 City, 48 Highway</td> </tr> <tr> <td></td> <td>2.4 gallons/100 mi</td> <td>2.0 gallons/100 mi</td> </tr> </tbody> </table>		2003 Toyota Prius	2012 Toyota Prius	<b>EPA Fuel Economy</b>				<b>41</b>	<b>50</b>		Combined	Combined	Miles per Gallon	42 City, 41 Highway	51 City, 48 Highway		2.4 gallons/100 mi	2.0 gallons/100 mi										
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<p>C8</p>	<p>Third is the ongoing improvement in hybrid fuel economy. The Prius miles per gallon increased from 41 to 46 in the first five years and from 46 to 50 in the following six years. The car's MPG improvement rate has been an impressive 2 percent per year, well above industry standards.</p>	<table border="1"> <caption>Prius MPG Evolution</caption> <thead> <tr> <th></th> <th>Tank to Wheels</th> <th>Well to Wheels</th> </tr> </thead> <tbody> <tr> <td>1999 Prius MPG</td> <td>41</td> <td>34</td> </tr> <tr> <td>2004 Prius MPG</td> <td>46</td> <td>38</td> </tr> <tr> <td>2010 Prius MPG</td> <td>50</td> <td>42</td> </tr> <tr> <td>2016 Prius MPG</td> <td>55</td> <td>46</td> </tr> </tbody> </table>		Tank to Wheels	Well to Wheels	1999 Prius MPG	41	34	2004 Prius MPG	46	38	2010 Prius MPG	50	42	2016 Prius MPG	55	46													
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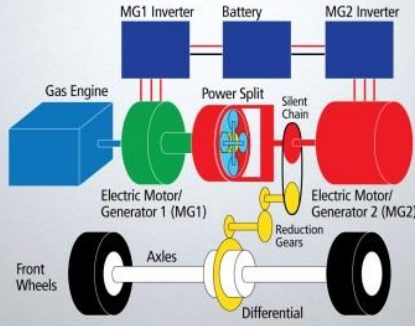


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C9	<p>At the same time, the efficiency of electric drive trains has not improved substantially. The miles-per-gallon equivalent for the 2013 RAV4 EV is less than the original 2002 RAV4 EV version.</p>	 <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">EPA Fuel Economy</th> </tr> <tr> <th colspan="2">ELECTRICITY</th> </tr> </thead> <tbody> <tr> <td colspan="2" style="text-align: center;"><b>78</b> Combined</td> </tr> <tr> <td style="text-align: center;">87 City</td> <td style="text-align: center;">69 Highway</td> </tr> <tr> <td colspan="2" style="text-align: center;"><small>43 kW-hrs/100 mi</small></td> </tr> <tr> <td colspan="2" style="text-align: center;"><b>76</b> Combined</td> </tr> <tr> <td style="text-align: center;">78 City</td> <td style="text-align: center;">74 Highway</td> </tr> <tr> <td colspan="2" style="text-align: center;"><small>44 kW-hrs/100 mi</small></td> </tr> </tbody> </table>	EPA Fuel Economy		ELECTRICITY		<b>78</b> Combined		87 City	69 Highway	<small>43 kW-hrs/100 mi</small>		<b>76</b> Combined		78 City	74 Highway	<small>44 kW-hrs/100 mi</small>	
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C10	<p>Fourth, the cost of lithium-ion batteries did not come down as much as was projected. Worldwide, 8.7 billion dollars were invested over a five-year period in battery development and manufacturing that resulted in a decrease in battery costs of about 50 percent, well below expectations. Lithium-ion batteries are still too costly for mass market vehicles.</p>																	
C11	<p>The luxury Karma plug-in hybrid required a total investment of 1.4 billion dollars. After a few hundreds were sold, the company stopped production and laidoff its staff.</p>	<p style="text-align: center; color: green;"><b>Karma Luxury Plug-in Hybrid</b></p> 																
C12	<p>The U.S. government has been the main promoter of the cars, giving plug ins massive amounts of funding – yet success has been limited. Toyota, on the other hand, has spent 20 years developing the gasoline hybrid which still outperforms plug-ins on most measures.</p>																	



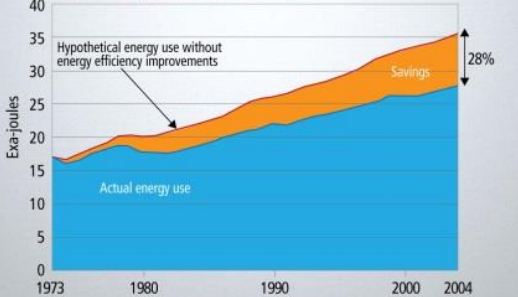

Part 5B: Conclusion – Power Grid Perspectives																														
C13	<p>The performance and metrics of electric cars are intertwined with the performance of the power grid.</p>																													
C14	<p>The main benefit of improved electric vehicle batteries is to increase the vehicle range. But batteries have little effect on energy consumption and CO<sub>2</sub> emissions which are determined by the efficiency of the power plants and electricity transmission networks.</p>																													
C15	<p>Power plant efficiency does not improve rapidly. Projections for conventional coal and natural gas plants show marginal potential improvements. It will be decades before the national grid is efficient enough to justify the extra costs of plug-in cars.</p>	 <table border="1"> <caption>Power Plant Efficiency Trend (BTU/KWh)</caption> <thead> <tr> <th>Year</th> <th>BTU/KWh</th> </tr> </thead> <tbody> <tr><td>1950</td><td>15,000</td></tr> <tr><td>1960</td><td>10,500</td></tr> <tr><td>1970</td><td>10,500</td></tr> <tr><td>1980</td><td>10,500</td></tr> <tr><td>1990</td><td>10,200</td></tr> <tr><td>2000</td><td>10,000</td></tr> <tr><td>2010</td><td>9,800</td></tr> <tr><td>2020</td><td>9,500</td></tr> <tr><td>2030</td><td>9,200</td></tr> </tbody> </table>	Year	BTU/KWh	1950	15,000	1960	10,500	1970	10,500	1980	10,500	1990	10,200	2000	10,000	2010	9,800	2020	9,500	2030	9,200								
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C16	<p>Wind and solar photovoltaic are the most rapidly growing renewable technologies. But their combined percent share of electricity generation is still very small in the US, about 3 percent in 2013.</p>	 <table border="1"> <caption>Wind/Solar % of Energy 2001-2013</caption> <thead> <tr> <th>Year</th> <th>% of Energy</th> </tr> </thead> <tbody> <tr><td>2001</td><td>0.2%</td></tr> <tr><td>2002</td><td>0.2%</td></tr> <tr><td>2003</td><td>0.2%</td></tr> <tr><td>2004</td><td>0.2%</td></tr> <tr><td>2005</td><td>0.3%</td></tr> <tr><td>2006</td><td>0.4%</td></tr> <tr><td>2007</td><td>0.5%</td></tr> <tr><td>2008</td><td>0.8%</td></tr> <tr><td>2009</td><td>1.1%</td></tr> <tr><td>2010</td><td>1.4%</td></tr> <tr><td>2011</td><td>1.7%</td></tr> <tr><td>2012</td><td>2.0%</td></tr> <tr><td>2013</td><td>2.3%</td></tr> </tbody> </table>	Year	% of Energy	2001	0.2%	2002	0.2%	2003	0.2%	2004	0.2%	2005	0.3%	2006	0.4%	2007	0.5%	2008	0.8%	2009	1.1%	2010	1.4%	2011	1.7%	2012	2.0%	2013	2.3%
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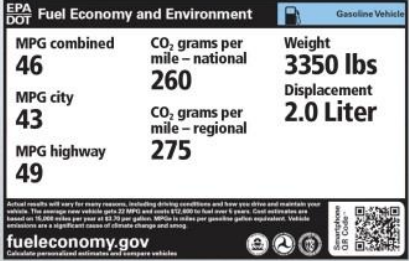


<p>C17</p>	<p>Renewables will gradually reduce the average amount of carbon dioxide generated per kilowatt-hour. But change will be slow. Increasing the share of all renewables, including hydroelectric, to 11 percent of electricity will likely take 30 years.</p>																	
<p>C18</p>	<p>Homes and buildings consume a great deal of electrical energy – far more than is used to operate electric cars. Since most cars will be charging in the evening, renewable electricity generated during the day will be used primarily in buildings.</p>	<table border="1"> <thead> <tr> <th>System</th> <th>Annual Energy Use (kWh)</th> </tr> </thead> <tbody> <tr> <td>Home Heating System</td> <td>3,523 kWh</td> </tr> <tr> <td>Central Air Conditioning</td> <td>2,796 kWh</td> </tr> <tr> <td>Refrigerator/Freezer</td> <td>2,610 kWh</td> </tr> <tr> <td>Water Heater</td> <td>2,552 kWh</td> </tr> <tr> <td><b>Chevrolet Volt</b></td> <td><b>2,520 kWh</b></td> </tr> <tr> <td>Clothes Dryer</td> <td>1,079 kWh</td> </tr> <tr> <td>Lighting</td> <td>940 kWh</td> </tr> </tbody> </table>	System	Annual Energy Use (kWh)	Home Heating System	3,523 kWh	Central Air Conditioning	2,796 kWh	Refrigerator/Freezer	2,610 kWh	Water Heater	2,552 kWh	<b>Chevrolet Volt</b>	<b>2,520 kWh</b>	Clothes Dryer	1,079 kWh	Lighting	940 kWh
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<p>C19</p>	<p>The grid is often portrayed as a storage battery for renewables; but electricity must be used as it is created. Often an electric car is not available for charging when electricity from renewables is being generated. As a result electricity from wind and solar will be applied first to buildings and industry rather than transportation.</p>																	
<p>C20</p>	<p>Ultimately the allocation of electricity between building machinery and cars will be determined by the advances in the efficiency of the machinery as compared to advances in the efficiency of cars. If the conventional hybrid car improves efficiency faster than building machines, then clean electrons are best applied in the home rather than in transport.</p>																	

Part 4C: Conclusion - Recommendations		
C21	<p>Customer expectations have been inflated by power companies, environmental groups, and national and state governments. The misleading car window stickers have added to the misrepresentations</p>	<p><b>Conclusion</b></p> <p>Plug-In Vehicles – the Score Power Grid Perspectives Recommendations</p>
C22	<p>U.S. government policy should shift to supporting conventional hybrids over plug-in vehicles. Hybrid sales today are still only about 3 percent of all cars sold in the US. But they are about 40 percent more efficient than their conventional gasoline counterparts.</p>	<p><b>Schematic of a Hybrid Engine</b></p> 
C23	<p>Hybrids should be made as small and as light as possible, continuing in the direction set by the Prius c,...</p>	<p><b>Toyota Prius C – 50MPG</b></p> 
C24	<p>...the Yaris Hybrid in Europe,...</p>	<p><b>Toyota Yaris Hybrid</b></p> 

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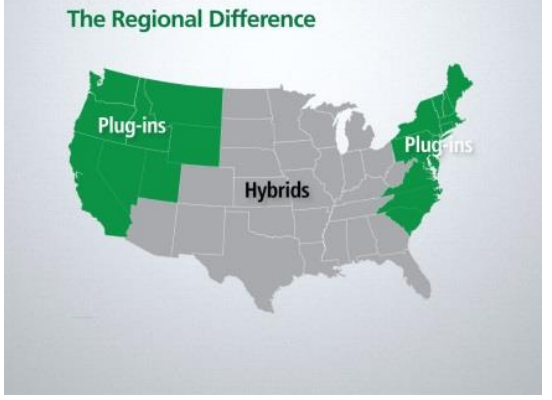
<p>C25</p>	<p>...and the Honda Hybrid Fit, yet to be introduced into the U.S.</p>	<p><b>Honda Fit Hybrid</b></p> 
<p>C26</p>	<p>Toyota will continue to represent the gold standard for fuel economy with its steady year-to-year improvement in efficiency. The lightweight Toyota 4 seater FT bH -hybrid concept car gets over 100 miles per gallon.</p>	<p><b>Toyota FT-Bh – 112MPG Concept Hybrid</b></p> 
<p>C27</p>	<p>Toyota will likely improve hybrid fuel economy at a 1.5 to 2 percent yearly rate, with cars equivalent to the size of the Prius C getting 80 miles per gallon by 2050. This is higher than the historical improvement of about 1% per year for conventional cars.</p>	<p><b>Long-term Passenger Transport Energy Efficiency Improvements</b></p> 
<p>C28</p>	<p>The company's new Lift-back version of the Prius will obtain 55 miles per gallon first customer shipments with first shipments likely to be in early 2016.</p>	<p><b>Next Release Prius</b></p> 

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<p>C29</p>	<p>Toyota dominates the hybrid market with its large number of models offered. It may take decades for American car makers to catch up. The U.S. focus on fuel cell cars and then plug-in hybrids has resulted in a lost opportunity for American car makers.</p>	<p><b>Toyota's Many Hybrids</b></p> 																					
<p>C30</p>	<p>The EPA needs to clear up the confusion surrounding well-to-wheels versus tank-to-wheels on the window sticker. And, the agency needs to provide regional data for miles-per-gallon measurements and carbon dioxide emissions. Accurate information would accelerate the public's move to more and more efficient hybrids.</p>	<p><b>Needed: A Better Window Sticker</b></p>  <table border="1"> <thead> <tr> <th colspan="2">EPA DOT Fuel Economy and Environment</th> <th>Gasoline Vehicle</th> </tr> </thead> <tbody> <tr> <td>MPG combined</td> <td>CO<sub>2</sub> grams per mile – national</td> <td>Weight</td> </tr> <tr> <td><b>46</b></td> <td><b>260</b></td> <td><b>3350 lbs</b></td> </tr> <tr> <td>MPG city</td> <td>CO<sub>2</sub> grams per mile – regional</td> <td>Displacement</td> </tr> <tr> <td><b>43</b></td> <td><b>275</b></td> <td><b>2.0 Liter</b></td> </tr> <tr> <td>MPG highway</td> <td></td> <td></td> </tr> <tr> <td><b>49</b></td> <td></td> <td></td> </tr> </tbody> </table> <p>Actual results will vary for every driver, including driving conditions and how you drive and maintain your vehicle. The average new vehicle gets 22 MPG and emits 315 grams of CO<sub>2</sub> per mile. CO<sub>2</sub> emissions are based on 10,000 miles per year at \$2.30 per gallon. EPA's 100-mile-per-gallon equivalent. Vehicle emissions and a significant cause of climate change and smog.</p> <p><a href="http://fuelconomy.gov">fuelconomy.gov</a> Calculate personalized estimates and compare vehicles</p>	EPA DOT Fuel Economy and Environment		Gasoline Vehicle	MPG combined	CO <sub>2</sub> grams per mile – national	Weight	<b>46</b>	<b>260</b>	<b>3350 lbs</b>	MPG city	CO <sub>2</sub> grams per mile – regional	Displacement	<b>43</b>	<b>275</b>	<b>2.0 Liter</b>	MPG highway			<b>49</b>		
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<p>C31</p>	<p>Dynamic Ride Sharing and carpooling is growing in the U.S. and should be a priority for the nation as the best way to reduce CO<sub>2</sub> emissions. This means 4 to 5 people in a car rather than 1 to 2.</p>	<p><b>Ridesharing to Reduce Energy Use</b></p> 																					
<p>C32</p>	<p>Ride sharing combined with hybrids will make it possible to cut carbon dioxide emissions from passenger transport by 80 percent within two decades.</p>	<p><b>Ridesharing to Reduce Energy Use</b></p>  <p>Information - all time</p> <ul style="list-style-type: none"> <li>No. of rides taken: 1</li> <li>No. of rides given: 4</li> <li>Distance Saved: 4 km</li> <li>\$ Saved: €3.75</li> <li>CO<sub>2</sub> Saved: 0.84 kg</li> </ul> <p><b>AVEGO</b></p>																					



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C33	<p>With accurate window stickers, plug-in cars can be marketed in particular regions where they have a significant advantage over hybrids. This will keep the technology alive but require less investment than trying to compete with hybrids across the country.</p>	 <p>The Regional Difference</p> <p>Plug-ins</p> <p>Hybrids</p> <p>Plug-ins</p>
C34	<p>The electric vehicle experiment that began in 1990 with the General Motors Impact has just about run its course. The hope of a two to three times the mile per gallon improvement over conventional cars was not realized. The challenge for Americans is to shift to smaller hybrid cars as fast as possible in order to halve CO<sub>2</sub> emissions by 2030. By that time new batteries and a revamp of the electrical grid could make plug-ins more competitive with hybrids.</p>	