

Hybrid vehicles that deliver major CO₂ and fuel economy improvements have been produced by a variety of automakers and across all major vehicle categories. The 2009-2010 models for sale in the U.S. that are shown in the figure below offer average reductions of CO₂ emissions per mile of 33% and increased fuel economy by 52%. Within these vehicles are compact cars, large sedans, crossovers, full-size sport utility vehicles, luxury vehicles, and full-size pick-up trucks. Note that these hybrid vehicle models have about 9% greater mass than their non-hybrid counterparts due to the electric systems (e.g., battery, motor, generator, power electronics). Also note that some available performance-oriented hybrid vehicles are not shown in the figure.

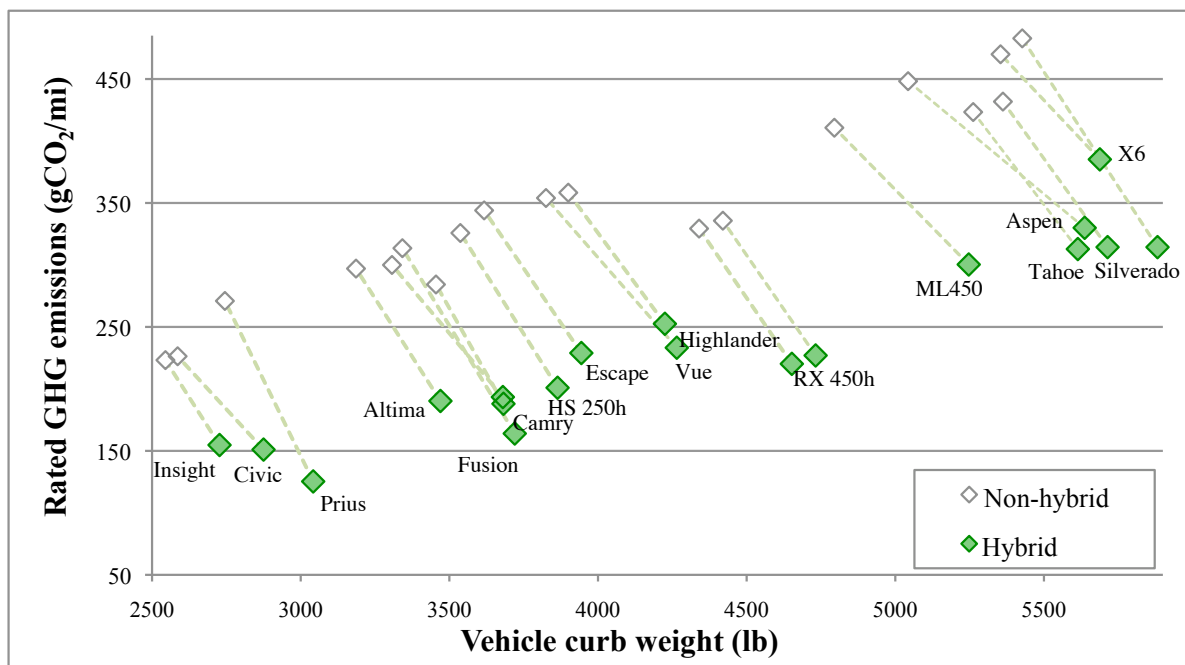


Figure 1. Comparison of U.S. 2009-2010 hybrid vehicles versus similar non-hybrid

Hybrid vehicle sales have been concentrated in two places - US and Japan. Overall, global hybrid vehicle sales of about 600,000 units in 2009 amount to about 1% of total automobile sales. About 90% of global hybrid sales are in the US and Japan. In percentage terms, the largest major market for hybrid vehicles in 2009 was Japan, where 5.4% of car sales were hybrids. The country with the highest gross hybrid sales in 2009 was the US, with about 290,000 sales. Within the US, the California market (about 11% of overall US sales) purchases hybrids at 5.3%, which is about the same rate as Japan car buyers, and about twice the rate of US hybrid purchasing.

Table 1. Sales of overall light-duty vehicles and hybrids in model year 2008

Sales region	Total vehicle sales in MY2009 (thousands)	Hybrid sales in MY2009 (thousands)	Hybrid sales percent of all vehicle sales
Japan	4,600	250	5.4%
California	1,144	61	5.3%
United States	10,429	290	2.8%
Outside US and Japan	35,000 (est)	59	0.2%
World	50,000 (est)	599	1.2%

Several automakers have commercialized hybrids in far greater numbers than others.

Toyota (including Lexus), in particular, sold 195,000 hybrid in the US, or about two-thirds of all the hybrids in the US. Hybrid sales from the Toyota group made up 11% of the company's 2009 sales. Honda and Ford had 2009 hybrid sales of about 2-3% of their fleets. Hybrid sales by Nissan and General Motors represented about 1% of their US sales. A number of new commercial hybrid models have recently been offered by BMW and Mercedes. All major automakers announced new hybrid offerings to come, and all actively showcase hybrid prototypes at international car shows.

Table 2. Hybrid vehicle technology deployment by automaker group in the US

Automaker group	Vehicle models		Cumulative US hybrid sales through MY2009	US hybrid sales in MY2009	Hybrid US MY2009 sales share for each automaker group
	Commercialized (MY1999-2010)	Announced (MY2010-2015)			
Toyota	<ul style="list-style-type: none"> • Prius • Camry • Highlander/400h • LS600h • HS250h • GS450h 	<ul style="list-style-type: none"> • Prius plug-in • Sienna • RAV4 	1,172,370	195,545	11.0%
Honda	<ul style="list-style-type: none"> • Insight • Civic • Accord 	<ul style="list-style-type: none"> • Fit • CR-Z • Odyssey 	258,753	35,691	3.1%
Ford	<ul style="list-style-type: none"> • Escape/Tribute/Mariner • Fusion/Milan 	<ul style="list-style-type: none"> • Escape plug-in 	124,241	33,520	2.0%
Nissan	<ul style="list-style-type: none"> • Altima 		26,564	9,357	1.2%
General Motors	<ul style="list-style-type: none"> • Silverado (Chev) • Yukon/Tahoe/Escalade • Vue (Saturn) • Malibu/Aura 	<ul style="list-style-type: none"> • Volt 	32,765	16,136	0.8%
Chrysler	<ul style="list-style-type: none"> • Aspen/Durango 	<ul style="list-style-type: none"> • Ram • Caravan 	46	0	0%
BMW	<ul style="list-style-type: none"> • ActiveHybrid X6 • ActiveHybrid 7 		0	0	0%
Mercedes	<ul style="list-style-type: none"> • ML 450 • S400 		0	0	0%
Hyundai-Kia		<ul style="list-style-type: none"> • Forte/Ray • Sonata • Accent 	0	0	0%
Volkswagen-Audi-Porsche		<ul style="list-style-type: none"> • Jetta • Touareg/Q7 • Cayenne • Panamara 	0	0	0%
All automaker groups			1,614,739	290,249	2.8%

The future market share of hybrids is highly unknown. While the US hybrid share is about 3% and California hybrid share is about 6%, the market-leader Toyota's US sales of hybrids are currently at about 11%. A number of announcements indicated that the number of hybrid offerings by automakers will continue to increase, and a variety of forecasts suggest overall hybrid sales will greatly increase in the next decade or two. Forecasts and assessments by consulting and research groups have indicated that hybrid sales could reach 1 to 3 million vehicles per year by model year by 2015. For comparison, with a U.S. auto market of 10-15 million light duty vehicle sales per year, these forecasts suggest a HEV sales share of roughly 10-30% by 2015-2029. More forward-looking studies forecasted hybrid sales shares in the US of between 30% and 50% by 2025. Forecasts from JD Power, US Department of Energy, Booz Allen, Kiplinger, National Research Council, Morgan Stanley, Pike Research, JP Morgan are shown in the figure below.

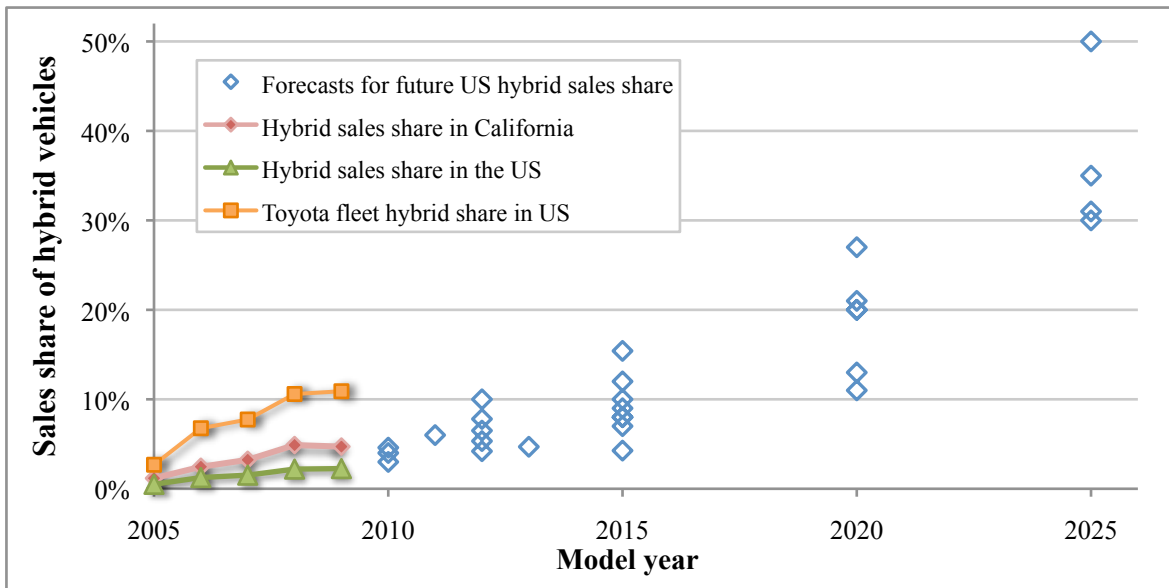


Figure 2. Hybrid sales shares data in the US, compared with future forecasts

There are a number of different hybrid types in the marketplace. In order of generally increasing electric component complexity are four general hybrid vehicle architectures: stop-start (or mild), parallel (or motor-assist), powersplit (or series-parallel), and two-mode (or compound powersplit). The different hybrid systems have different capabilities in reducing the energy use of the vehicle over its driving cycle. Different automakers have specialized in different hybrid types. Most hybrid sales (e.g., from Toyota, Ford, Nissan) have employed the powersplit-type system.

Table 3. Hybrid vehicle types, commercial vehicle models, and potential benefit

Hybrid type	Efficiency strategies				Companies	Example models	CO ₂ reduction compared to non-hybrid
	Engine off at idle	Motor assist	Regenerative braking	Electric only operation			
Mild / Stop-start	Yes				General Motors	Silverado, Malibu, Aura, Vue	5-15%
Parallel / motor-assist	Yes	Yes	Yes		Honda, Mercedes	Civic, Insight, S400	15-35%
Powersplit / Series-parallel	Yes	Yes	Yes	Yes	Toyota, Ford, Nissan	Prius, Fusion, Camry, Altima, Escape, Highlander, RX400h, HS250h	25-50%
Two-mode	Yes	Yes	Yes	Yes	General Motors, BMW, Mercedes, Chrysler	Tahoe, Silverado, Vue, Aspen, ML450, X6	25-50%