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Gaining Advantage in a Dynamic Project Landscape

Ten Thousand Foot Perspective on the Future of Non-Traditional Transportation Fuels

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Biofuels: Delivering on sector challenges (a perspective from BP)

PHIL NEW

CEO

BP Biofuels

Forward Looking Statements

This presentation contains forward-looking statements based on management's current expectations, estimates and projections. All statements that address expectations or projections about the future, including statements about the company's strategy for growth, product development, market position, expected expenditures and financial results are forward-looking statements. Some of the forward-looking statements may be identified by words like "expects," "anticipates," "plans," "intends," "projects," "indicates," and similar expressions. These statements are not guarantees of future performance and involve a number of risks, uncertainties and assumptions. Many factors could cause results to differ materially from those stated. These factors include, but are not limited to, changes in the laws, regulations, policies and economic conditions of countries in which the company does business; competitive pressures; successful integration of structural changes, including acquisitions, divestitures and alliances; research and development of new products, including regulatory approval and market acceptance, and seasonality of sales of agricultural products.

Biofuels: already a significant sector

- **Biofuels projections globally***

Assets operating	Assets under construction	Assets proposed
36,437 (mg)	9,803 (mg)	49,548 (mg)
868 (mbbl)	233 (mbbl)	1,180 (mbbl)
2.4 (mbd)	0.6 (mbd)	3.2 (mbd)

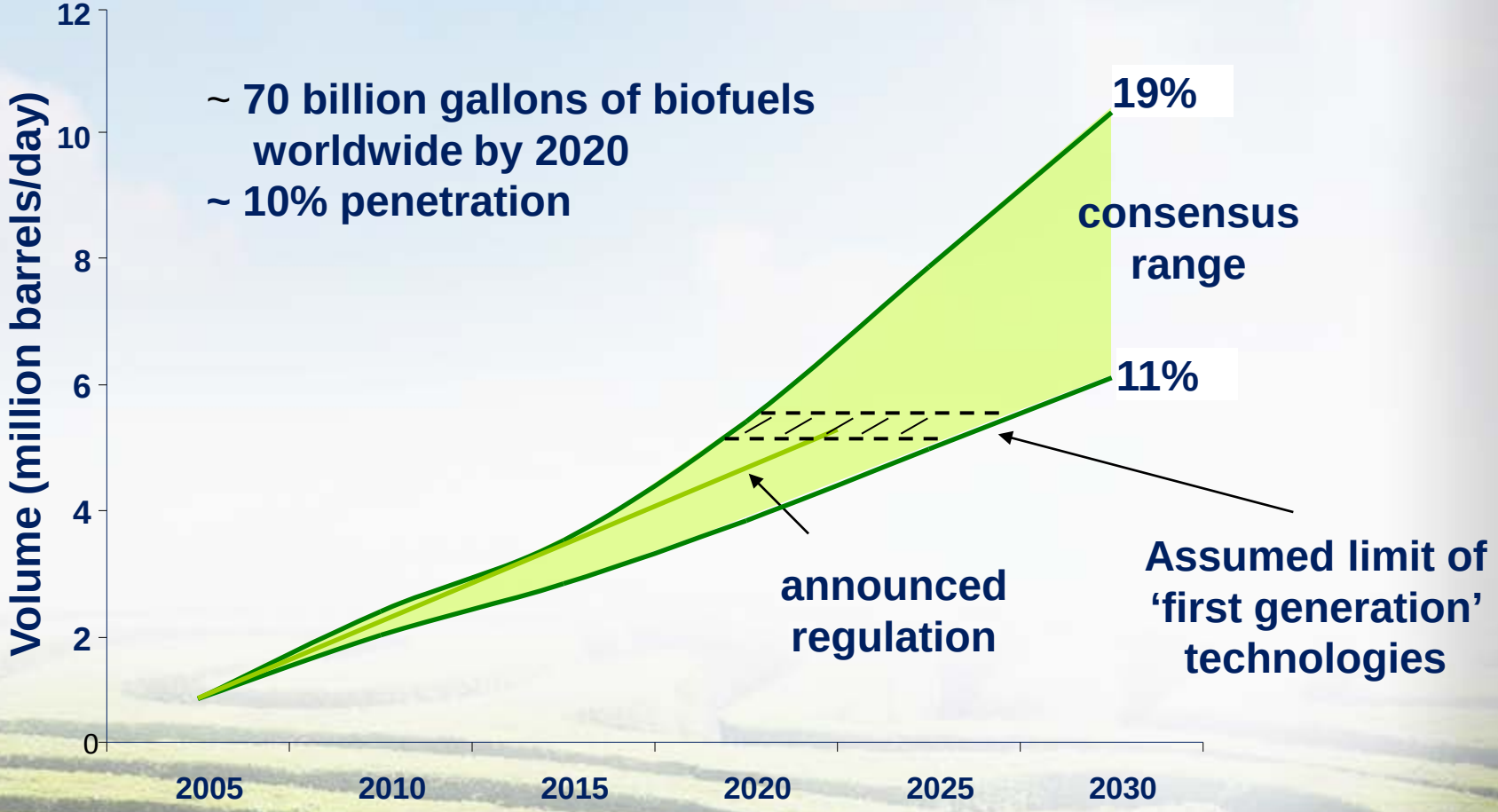
- **In the US***

Assets operating	Assets under construction	Assets proposed
12,674 (mg)	3,820 (mg)	28,061 (mg)
301.8 (mbbl)	90.9 (mbbl)	668.1 (mbbl)
0.8 (mbd)	0.25 (mbd)	1.8 (mbd)

*** source: Global Biofuels Centre data, August 2010**

Significant growth potential

Global biofuel penetration of gasoline/diesel demand



Source: McKinsey, BP analysis, IEA2007

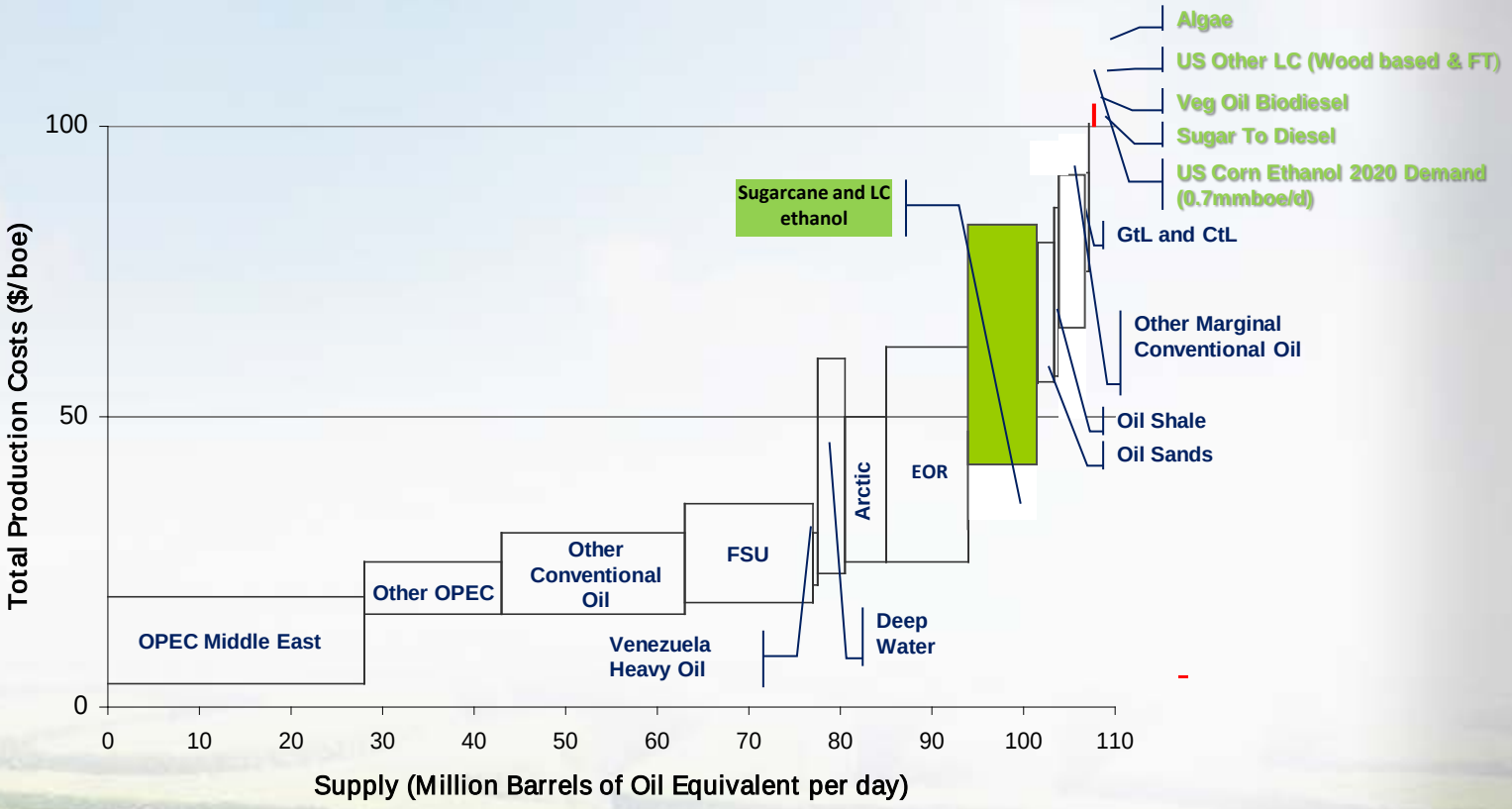
Biofuels: a complex activity set

Agronomy	Agriculture	Production at scale	Blending & Distribution
			
R&D • Feedstock technology • Conversion technology	Agricultural engineering	Demonstration capability	Design & engineering	Fuels marketing

Biofuels must be….

- **Low Cost**
  - $1 a gallon – or $40-50 a barrel on a straight volume basis.
- **Low Carbon**
  - Sugarcane ethanol up to 90% GHG benefit
- **Scalable**
  - Meet market demands
- **Sustainable**
  - Our licence to operate

Ethanol from sugarcane and energy grasses compete



Source: adapted from Booz Allen Hamilton analysis based on information from IEA, DOE and interviews with super majors; IBGE, UNICA, Conab, CGEE, Unicamp, CTC, , BP Biofuels Team

BP's response….

UK: Bioethanol plant under construction

US: LC demonstration plant, Jennings, Louisiana

Brazil: Tropical Bio Energia refinery

Brazil: Sugar cane harvesting

US: Energy cane fields, Florida

US Case Study: lignocellulosic ethanol

- **Using enzymes to convert energy cane to ethanol in the US**
- **Scale-up is the challenge**
- **Feedstock choice impacts yield and land requirement**

DATA	UNIT	VALUE
RFS2 cellulosic biofuel requirement (2022)	billion gallons	**16**
Average cellulosic plant capacity	million gallons	**75**
Capacity utilization	%	**90**
Approximate number of plants needed to satisfy RFS2 requirement	number	**200**
200 plants @ USD 5 – 10 per gallon capex cost	Billion US $	**80 - 160**

Conclusion

- Biofuels are real
- Significant opportunities in the sector
- The sector must work together to build a commercial scale biofuels industry
- There is real opportunity across the value-chain

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The Electrification of Transportation in the US: Future Prospects & Potential Impacts

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Hart Energy Consulting

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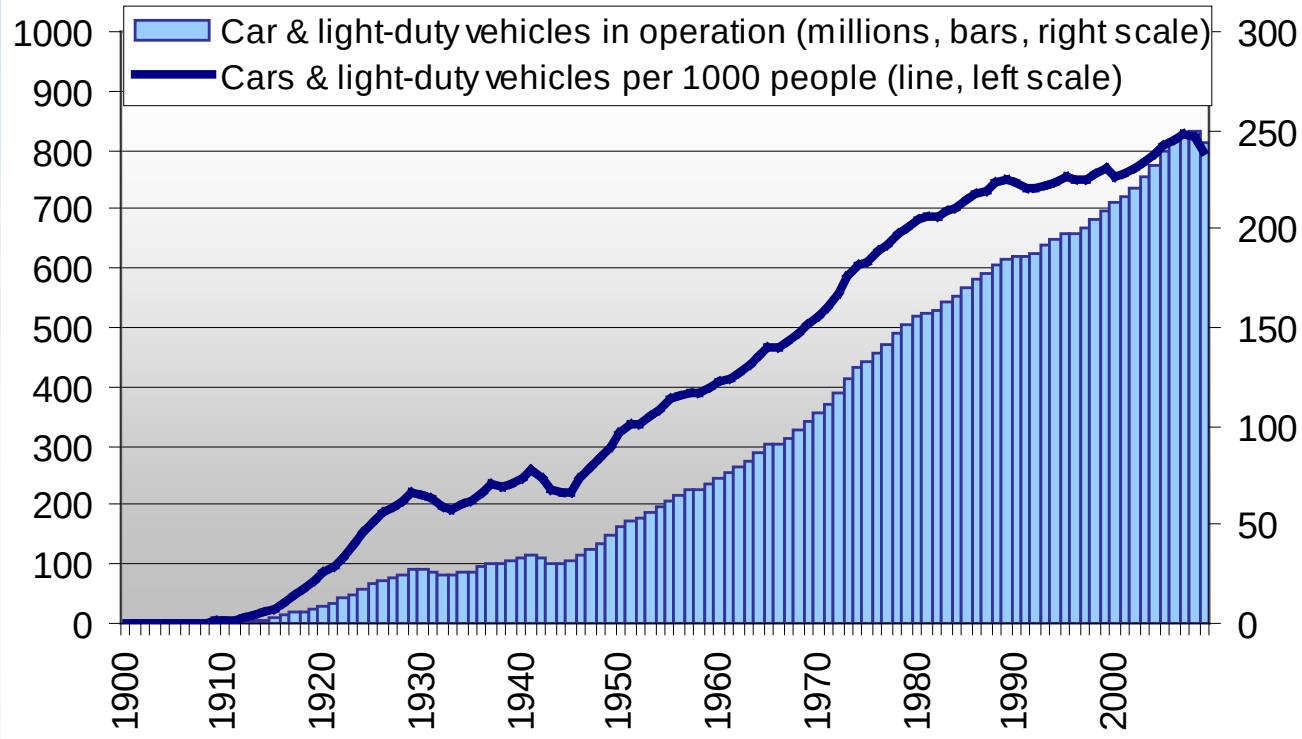
Key Points

- The Impact of Oil Prices, CO_2 Emissions & Fuel Economy Regulations
- Technical & Economic Feasibility of Vehicle Electrification
- The Current HEV Market Landscape
- Future Potential of Vehicle Electrification in the US
- Key Takeaways

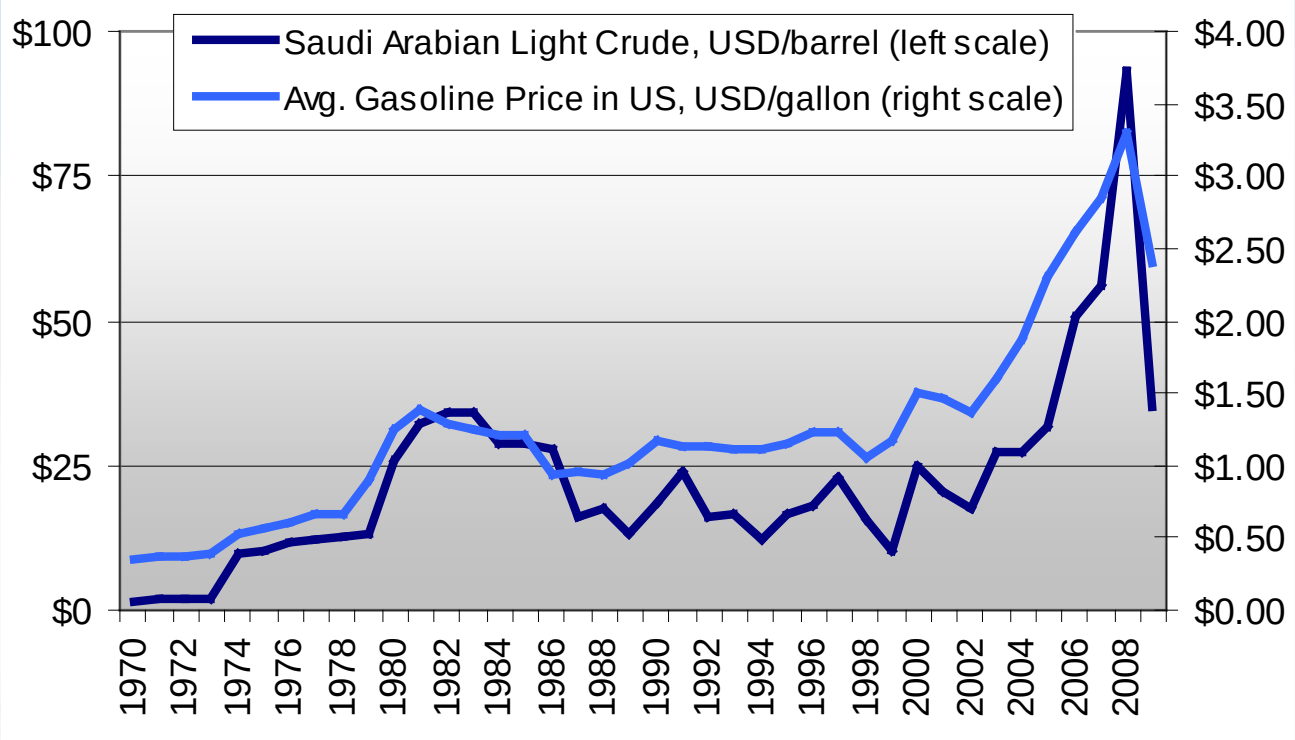
The Impact of Oil Prices, CO_2 Emissions & Fuel Economy Regulations



Sources: NHWA, DOT, R.L. Polk, HEC estimates

Growth of US vehicle stock has slowed in recently years, but there are still nearly 250 million light-duty vehicles out on the road today.

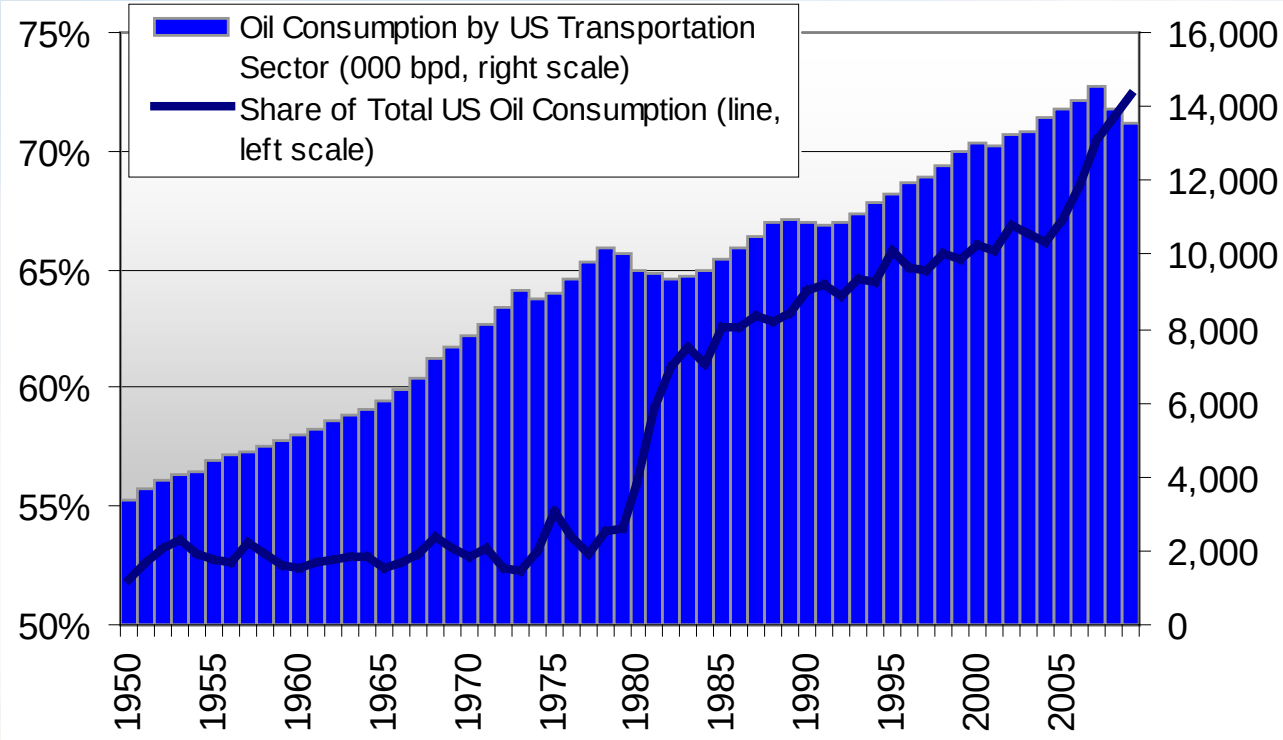
The Impact of Oil Prices, CO_2 Emissions & Fuel Economy Regulations



Sources: API, EIA

Oil & gasoline prices reached historical highs in 2008 & still remain relatively high ($75/barrel) despite a sharp economic slowdown.

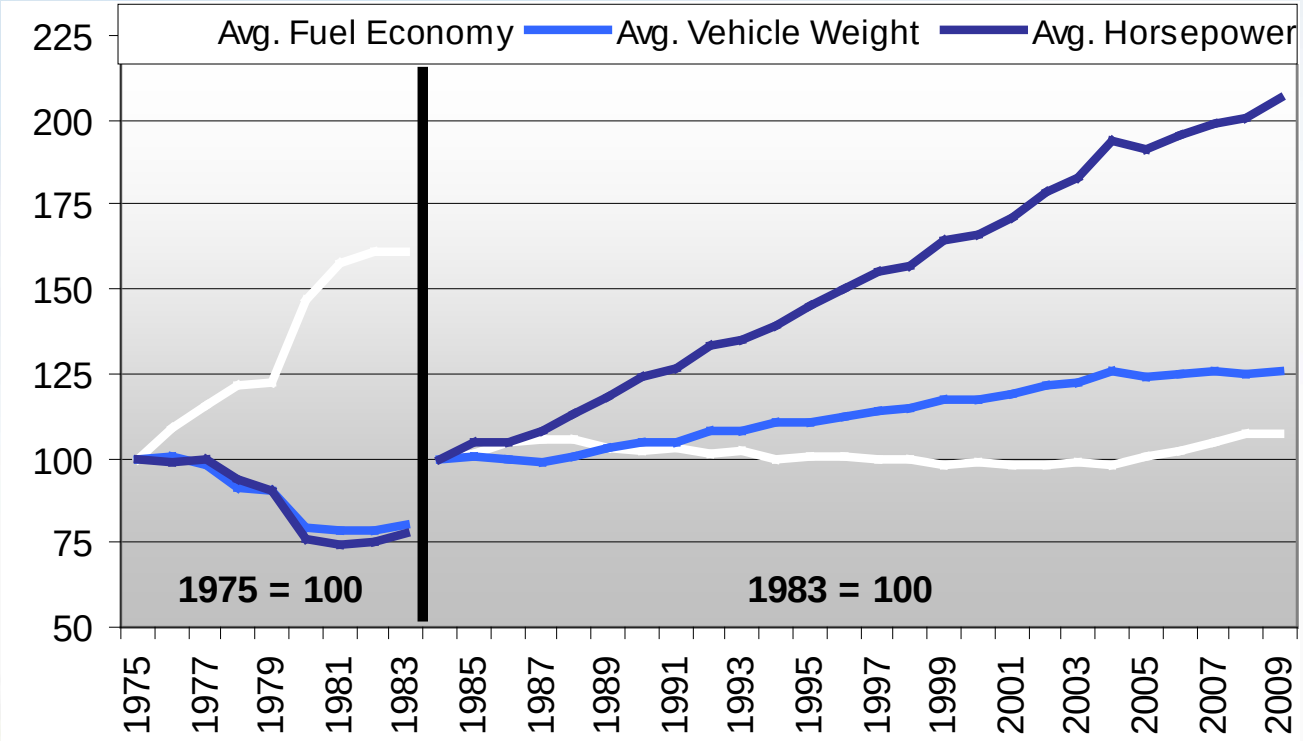
The Impact of Oil Prices, CO_2 Emissions & Fuel Economy Regulations



Source: EIA

The industrial sector & utilities have cut back on oil consumption, but the transportation sector has not => its share of total US oil consumption continues to grow.

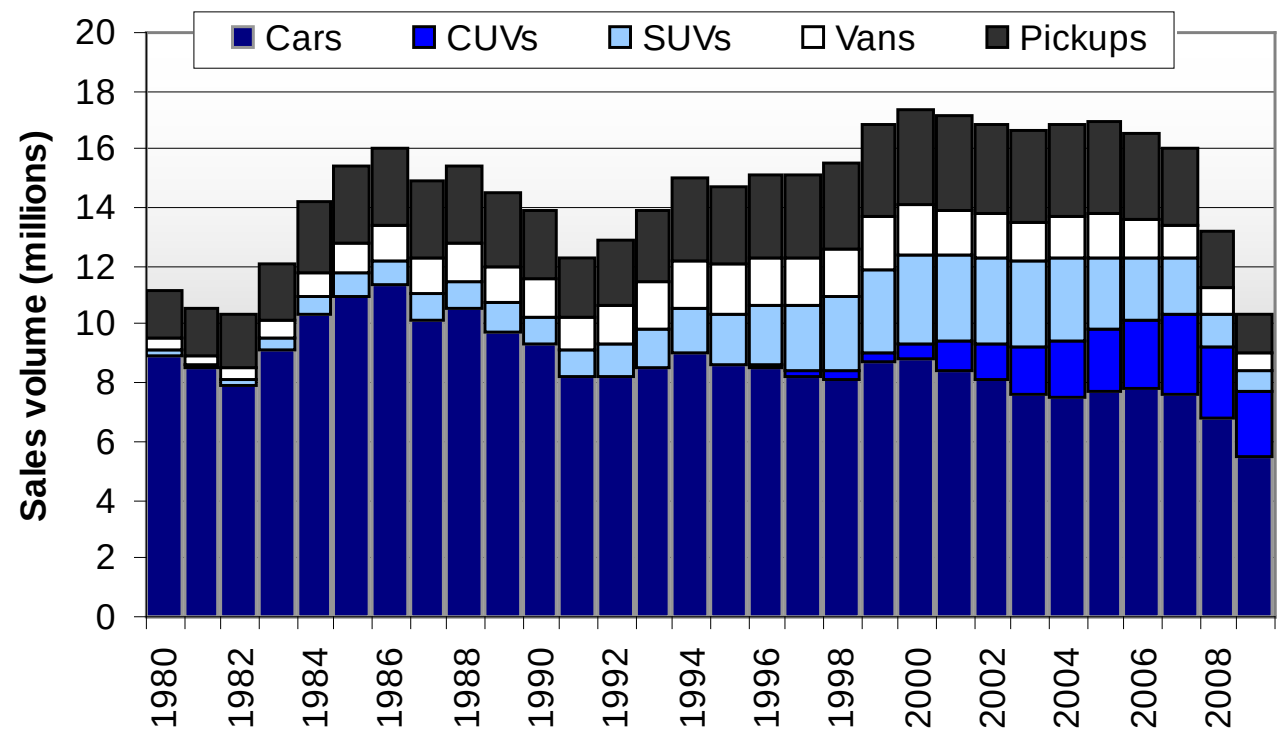
The Impact of Oil Prices, CO_2 Emissions & Fuel Economy Regulations



Source: HEC, based on EPA data

In the 1970s, OEMs improved fuel economy by reducing weight and horsepower, but since the early 1980s fuel economy (acc. to EPA method) has remained stagnant.

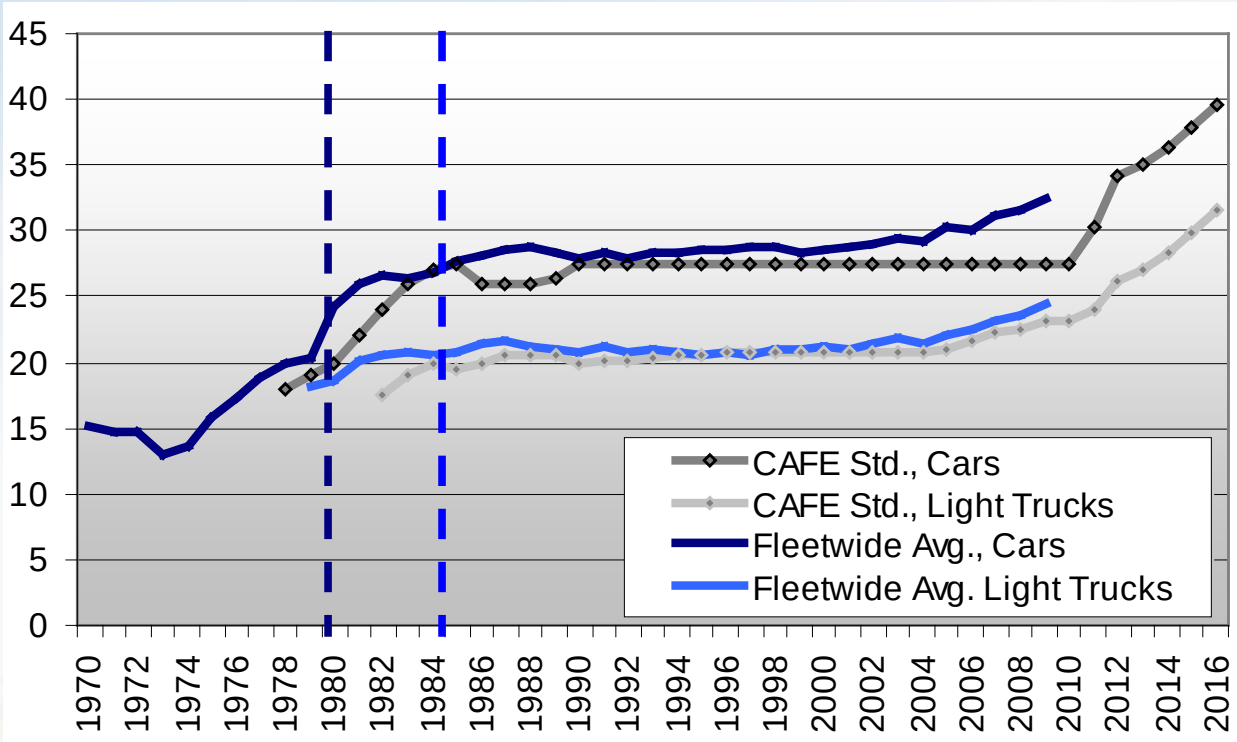
The Impact of Oil Prices, CO_2 Emissions & Fuel Economy Regulations



Source: Ward's Auto

Thanks to cheap gasoline, consumers found it affordable to purchase bigger vehicles like pickups and SUVs - but high oil prices and the recession have changed that.

The Impact of Oil Prices, CO_2 Emissions & Fuel Economy Regulations



Sources: NHTSA, EPA

Corporate Average Fuel Economy (CAFE) standards changed little in the 1980s and 1990s, but that was before age of high oil prices and global warming. CAFE will increase through 2016 and beyond.

Technical & Economic Feasibility of Vehicle Electrification

Technology	% CO2 Reduction	Cost	Cost per 1% CO2 Reduction
Reducing Mechanical Friction of Components	3.0%	$ 50	$ 17
Electric Steering	5.0%	$ 120	$ 24
Low Rolling Resistance Tires	3.0%	$ 150	$ 50
Light Weighting	10.0%	$ 750	$ 75
Variable valve lift and timing	4.9%	$ 410	$ 84
Cylinder deactivation	3.9%	$ 415	$ 106
Gasoline direct injection	7.5%	$ 825	$ 110
Turbocharging	6.9%	$ 800	$ 116
Mild Hybrid	12.0%	$ 1,400	$ 117
Start-stop system	3.9%	$ 470	$ 121
Moderate Hybrid	18.0%	$ 2,200	$ 122
HCCI	12.2%	$ 1,800	$ 148
Full Hybrid	35.0%	$ 6,000	$ 171

Source: HEC, based on Deutsche Bank, BCG, Edmunds, Anderman (2007) data

Vehicle electrification can help meet fuel economy and CO2 emissions goals, but in the short term they are not cost competitive.

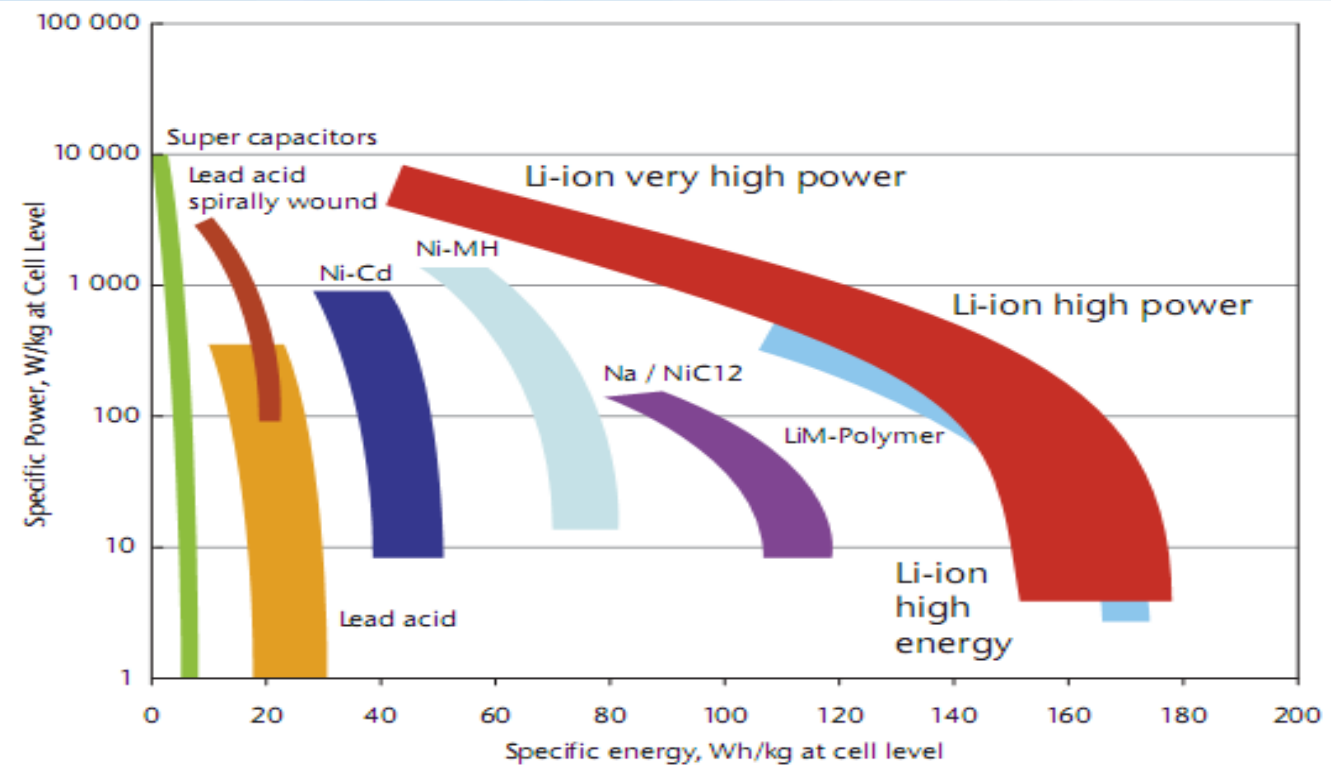
Technical & Economic Feasibility of Vehicle Electrification

Make & Model	Model Year	Trim	Engine	Price	Price Premium	EPA Combined MPG	Payback at $3.30/g (i.e. 2008 avg. US price (years)	Payback at $2.61/g (i.e. 2009 avg. US price (years)
Honda Civic	2010	EX	1.8L	$20,255	$1,045	29	**2.6**	**3.3**
Honda Insight	2010	EX	1.3L	$21,300		41		
Toyota Corolla	2010	XLE	1.8L	$17,750	$5,050	29	**8.8**	**11.1**
Toyota Prius	2010	I	1.8L	$22,800		50		
Toyota Camry	2010	SE	2.5L	$23,165	$3,285	26	**9.2**	**11.6**
Toyota Camry Hybrid	2010	Base	2.4L	$26,450		34		
Ford Escape	2010	XLT (FWD)	2.5L	$24,045	$5,815	23	**12.0**	**15.2**
Ford Escape Hybrid	2010	Base	2.5L	$29,860		32		
Ford Fusion	2010	SE	2.5L	$21,225	$6,725	25	**11.8**	**15.0**
Ford Fusion Hybrid	2010	Base	2.5L	$27,950		39		
Chevrolet Malibu	2010	LT1	2.4L	$22,715	$2,840	26	**18.0**	**22.8**
Chevrolet Malibu Hybrid	2009	Base	2.4L	$25,555		29		

Source: HEC, based on Edmunds, EPA, EIA data

Because of the high cost of hybrids today, their payback period is relatively long => their ability to gain market share has been limited.

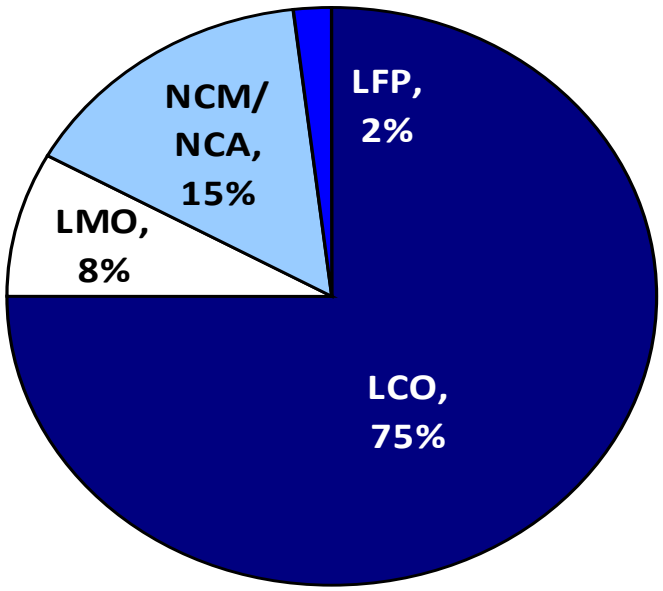
Technical & Economic Feasibility of Vehicle Electrification

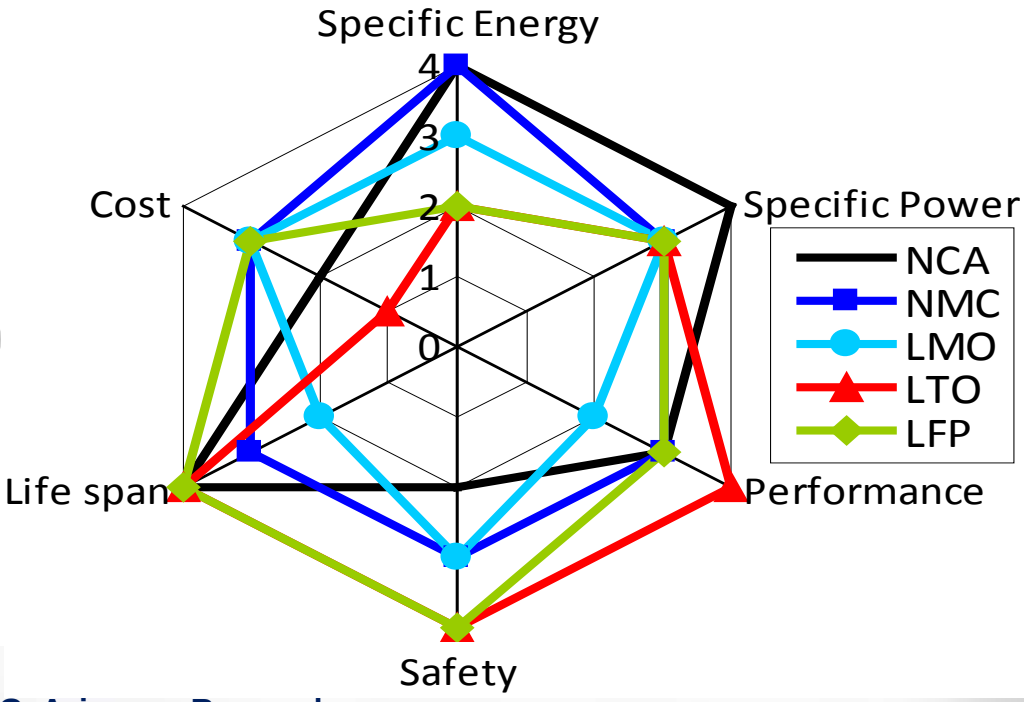


Source: Saft

The main reason for the high cost of hybrids is the high cost of their batteries. New chemistries can lower cost & improve performance.

Technical & Economic Feasibility of Vehicle Electrification

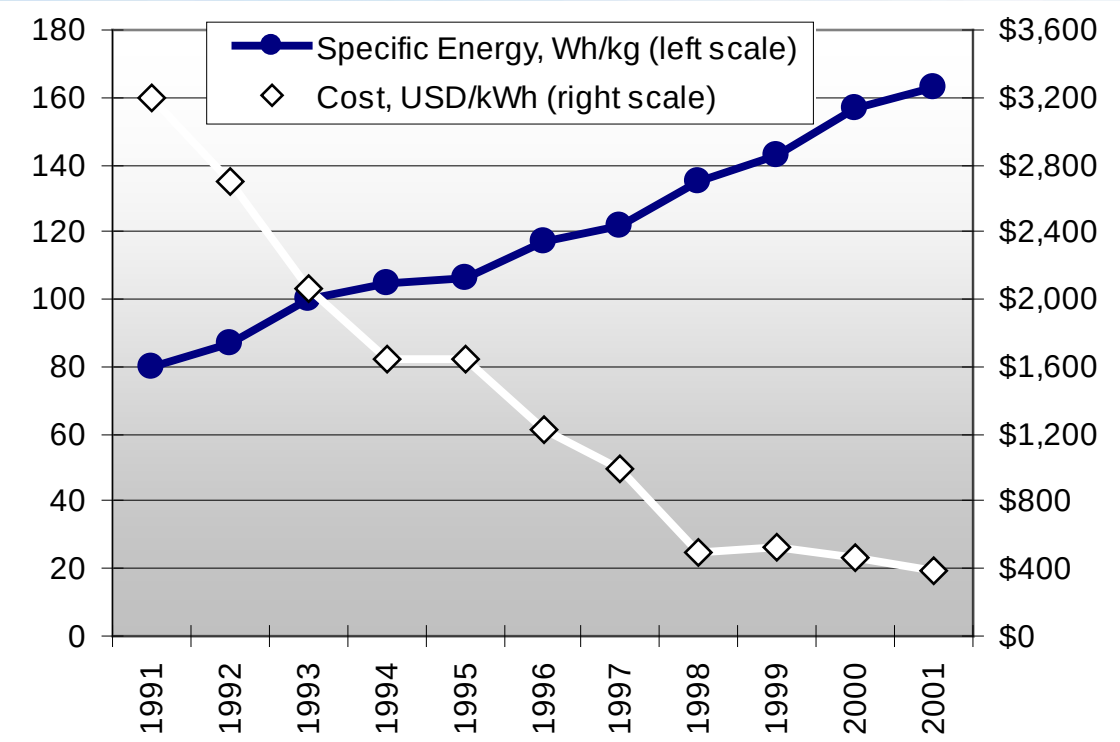




Sources: BCG, Avicenne Research

Li-Ion batteries - especially for automotive use - are not a mature technology. There are still many different chemistries vying for market share.

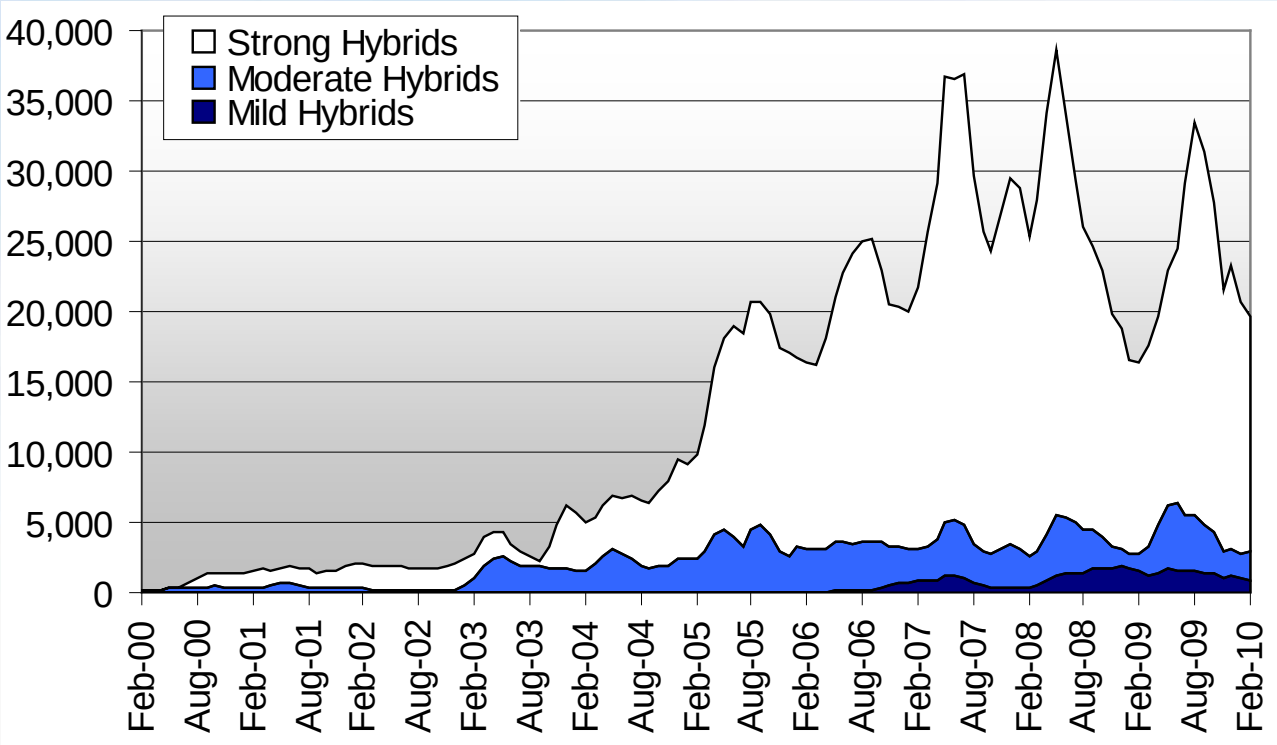
Technical & Economic Feasibility of Vehicle Electrification



Source: Brodd (2005)

As Li-Ion battery technology matures, more cost reductions can be expected - this has been the case with LCO batteries for laptops and cell phones.

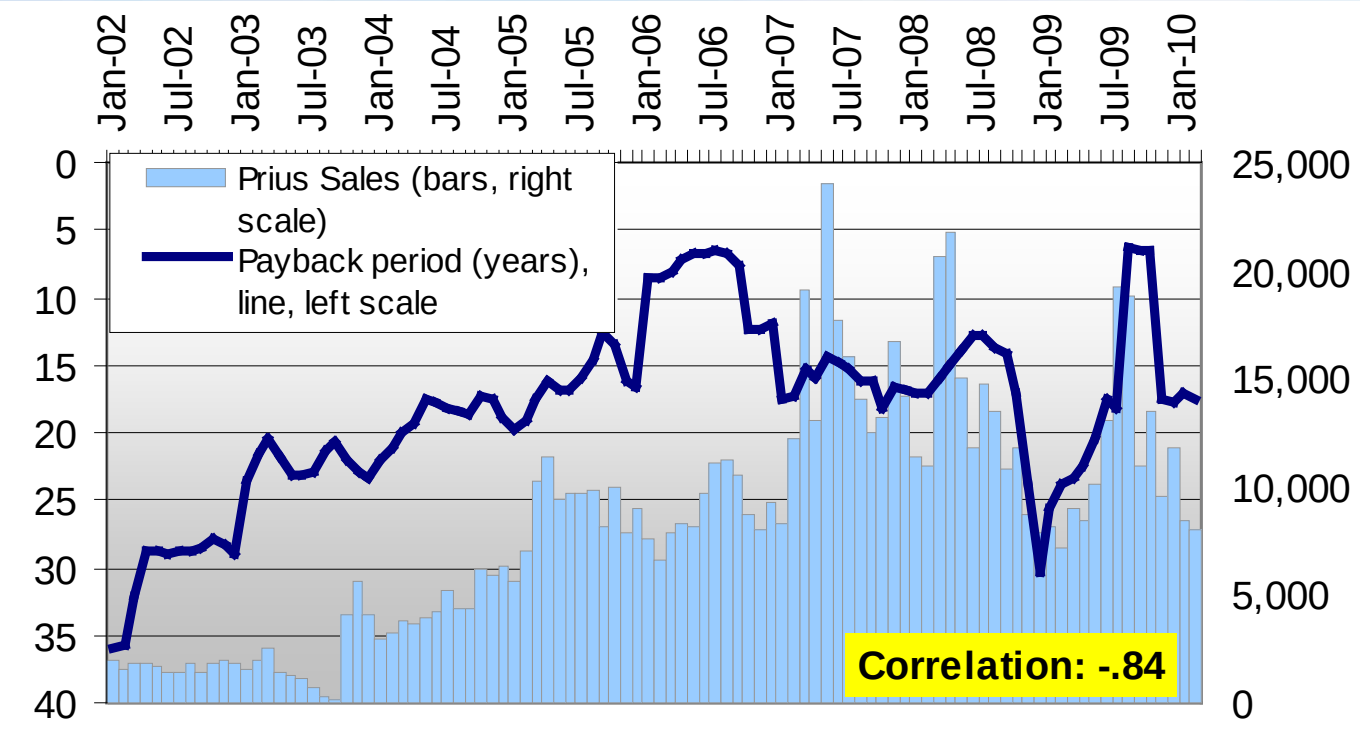
The Current HEV Market Landscape



Source: HEC, based on Ward's Auto data

Hybrids still comprise a small part of the light-duty vehicle market - but their share is growing. Consumers associate hybrids with fuel economy, so they have favored strong HEVs over mild & moderate HEVs.

The Current HEV Market Landscape

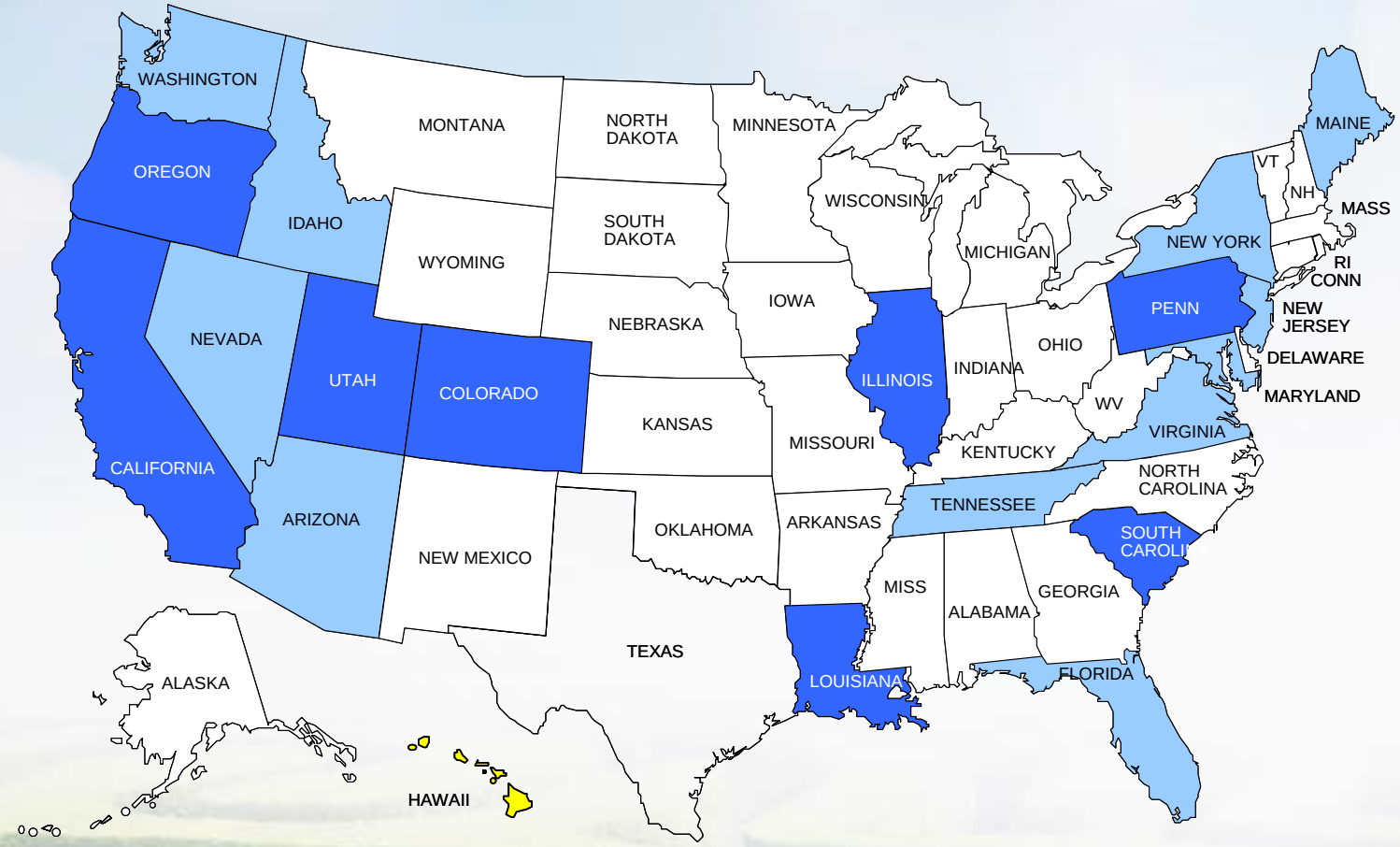


Note: Payback calculation is based on 12K mi/year of usage, and include the EPCAT and "Cash for Clunkers" incentives

Source: HEC, based on Ward's Auto, Edmunds, Automotive News, EIA data

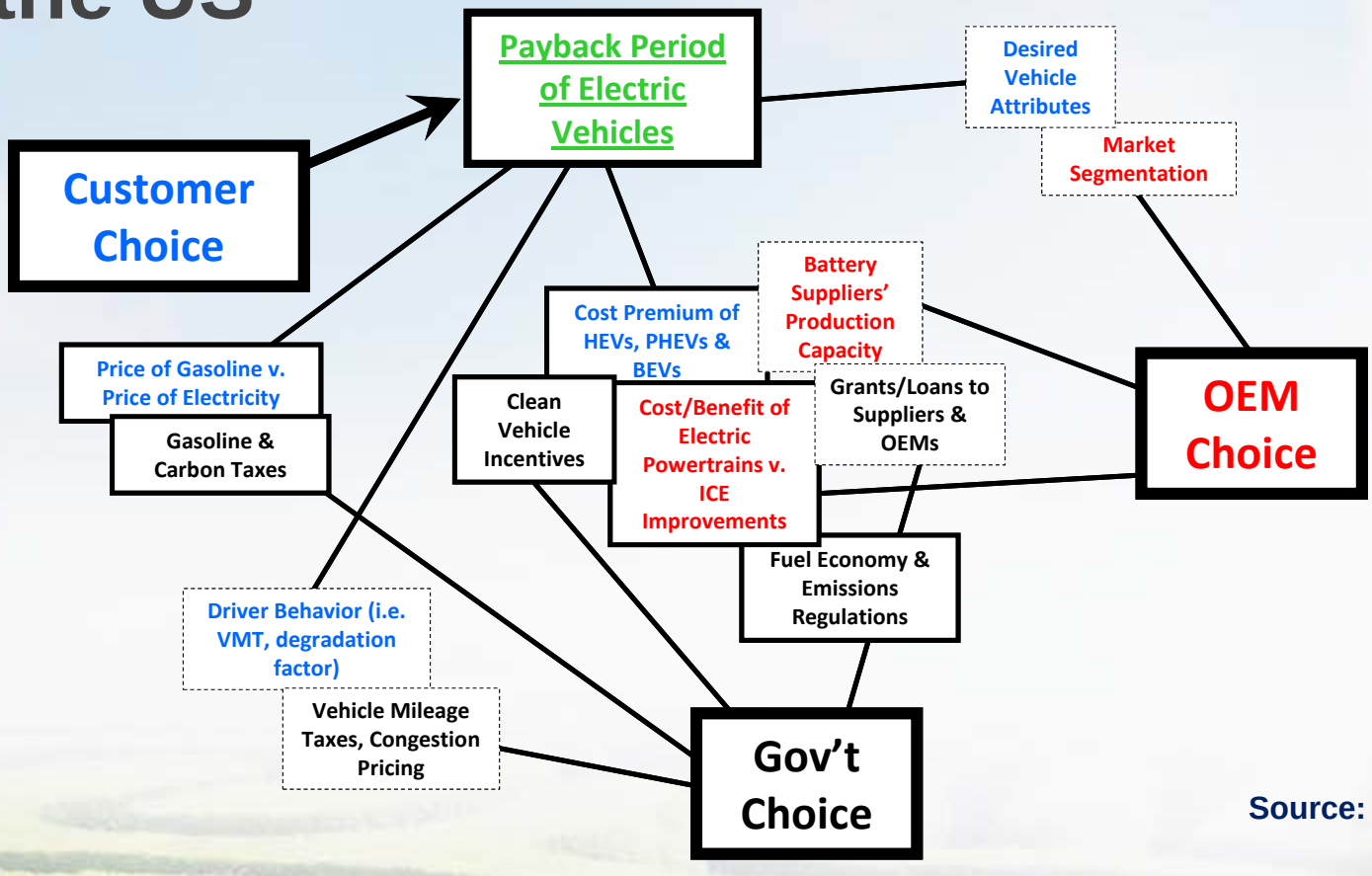
Sales of the Prius have shown a strong correlation to their payback period => it is not enough for a HEV to be "green," it has to offer good value.

The Current HEV Market Landscape



Governments- federal, state, local - are providing incentives for buyers and manufacturers of HEVs, PHEVs and EVs.

Future Potential of Vehicle Electrification in the US



Source: IEA

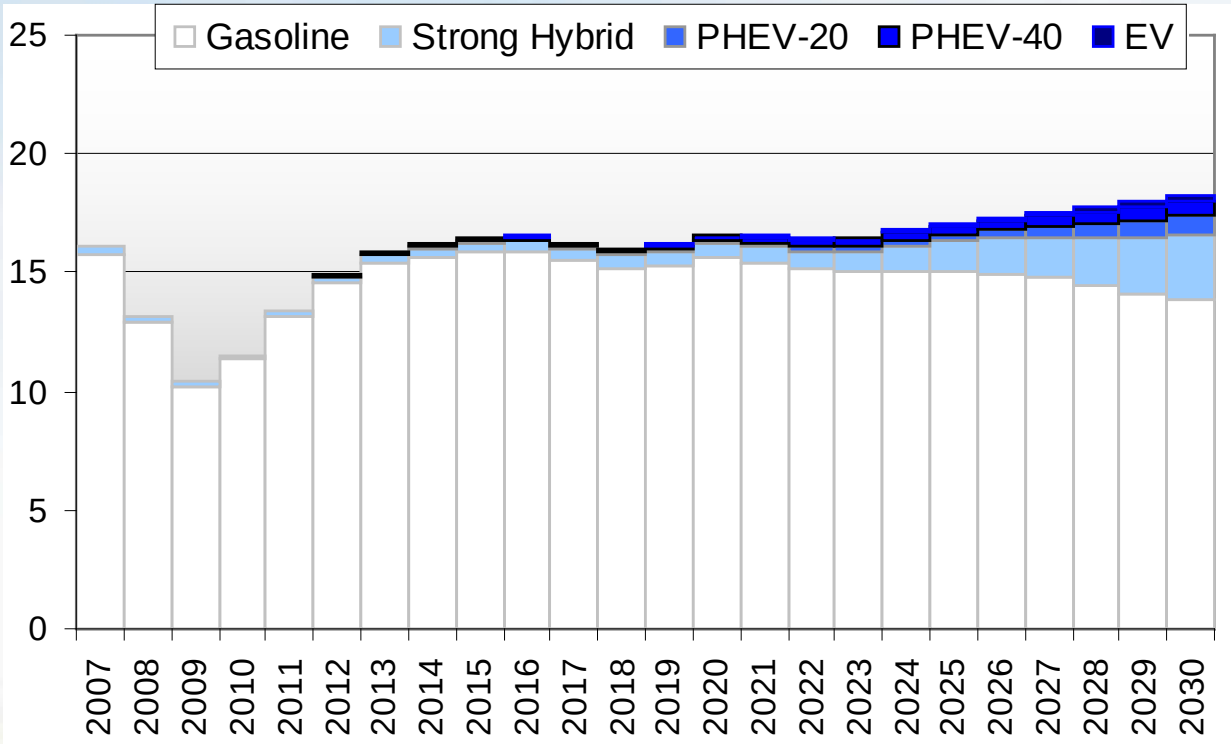
Sizing up the potential of electrification is complex: payback period is influenced by many relevant variables.

Future Potential of Vehicle Electrification in the US

		Base Case (i.e. 2009 WRFS)	"Green Renaissance" Scenario	"Realpolitik" Scenario
	Rationale		Test impact of "green" government policies on electrification	Test impact of resource nationalism and trade barriers on electrification
Parameters	**Fuel prices**	Grow moderately and gradually	Gov't introduces $4/gallon floor in 2011, and raises it to $5 in 2020	High
	CAFE Standards	Rise to 35.5 mpg by 2020; grow moderately thereafter	Rise to 42.5mpg by 2020; grow moderately thereafter	Rise to 35.5 mpg by 2016; grow moderately thereafter
	Government incentives for PHEVs & EVs	Are short-lived	Last until 2020	None
	Battery costs	Decline moderately	Decline quickly	Very little decline
	OEM and battery manufacturer capacity	Rises moderately	Rises moderately to 2020, and grows quickly thereafter	Rises slowly

Due to complexity & uncertainty, it is best to analyze a variety of possible scenarios.

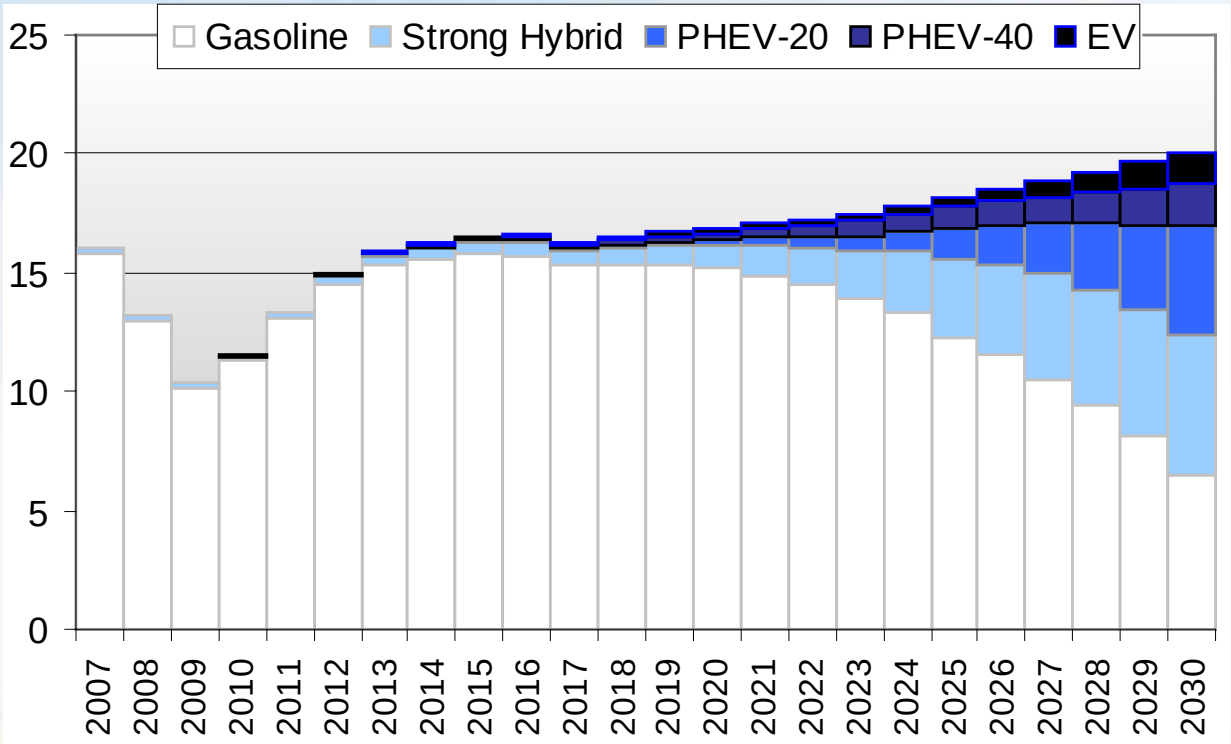
Future Potential of Vehicle Electrification, US Vehicle Sales: Base Case



Source: HEC

In the Base Case, penetration of vehicle electrification in the light-duty vehicle market grows moderately.

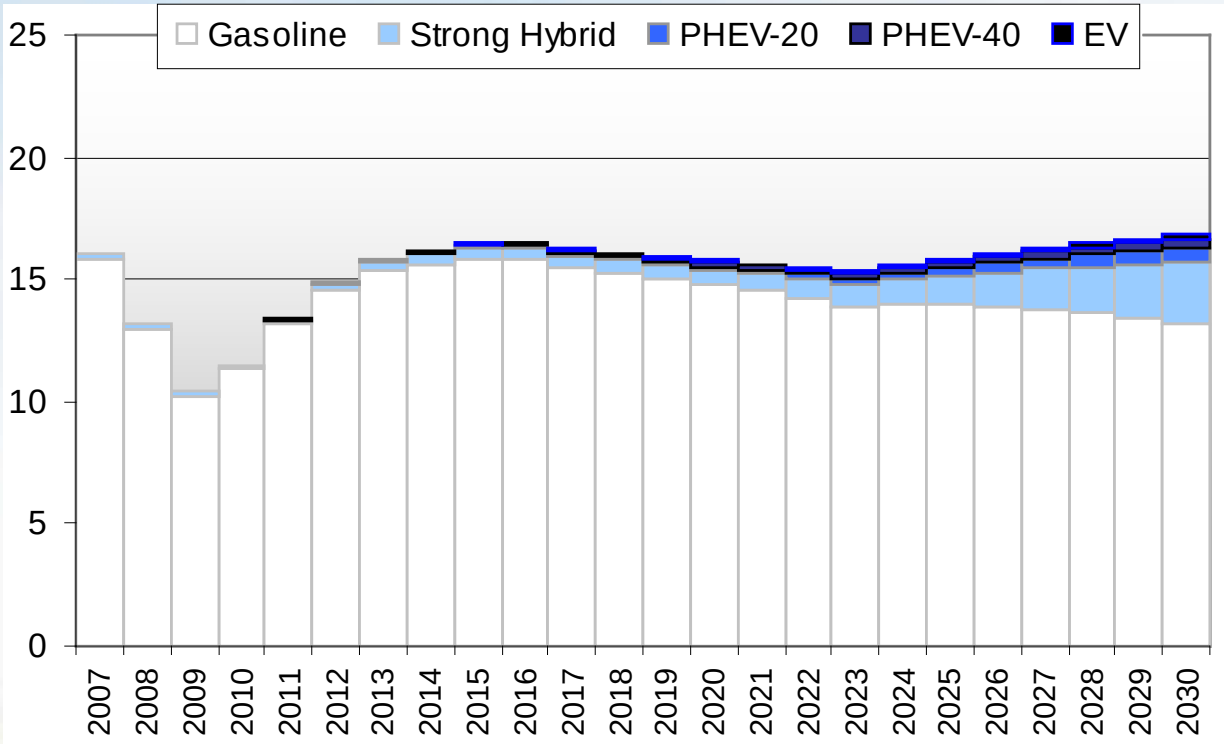
Future Potential of Vehicle Electrification, US Vehicle Sales: Green Renaissance



Source: HEC

In "Green Renaissance," the gasoline price floor, vehicle incentives & battery cost reductions combine to spur high levels of penetration after 2020.

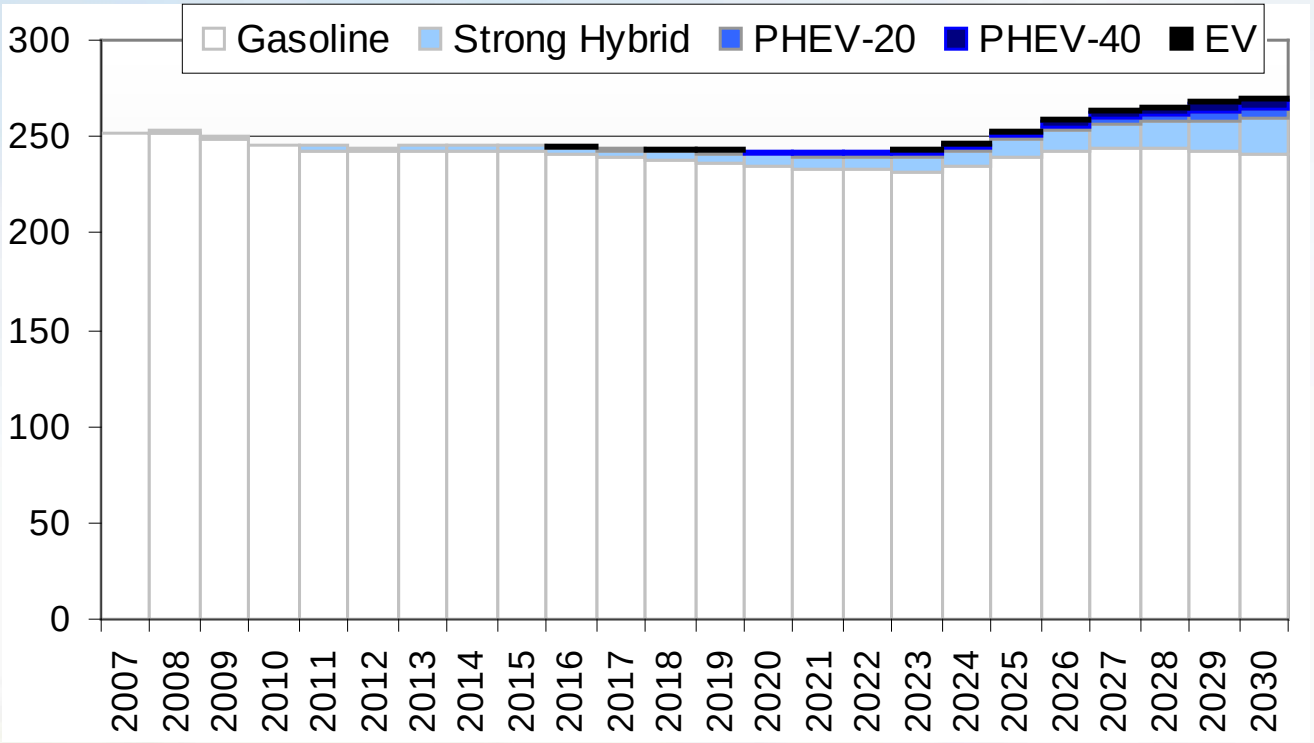
Future Potential of Vehicle Electrification, US Vehicle Sales: Realpolitik



Source: HEC

In "Realpolitik," vehicle electrification penetration is modest. Total light-duty vehicle sales also stagnate.

Future Potential of Vehicle Electrification, US Vehicle Fleet: Base Case



Source: HEC

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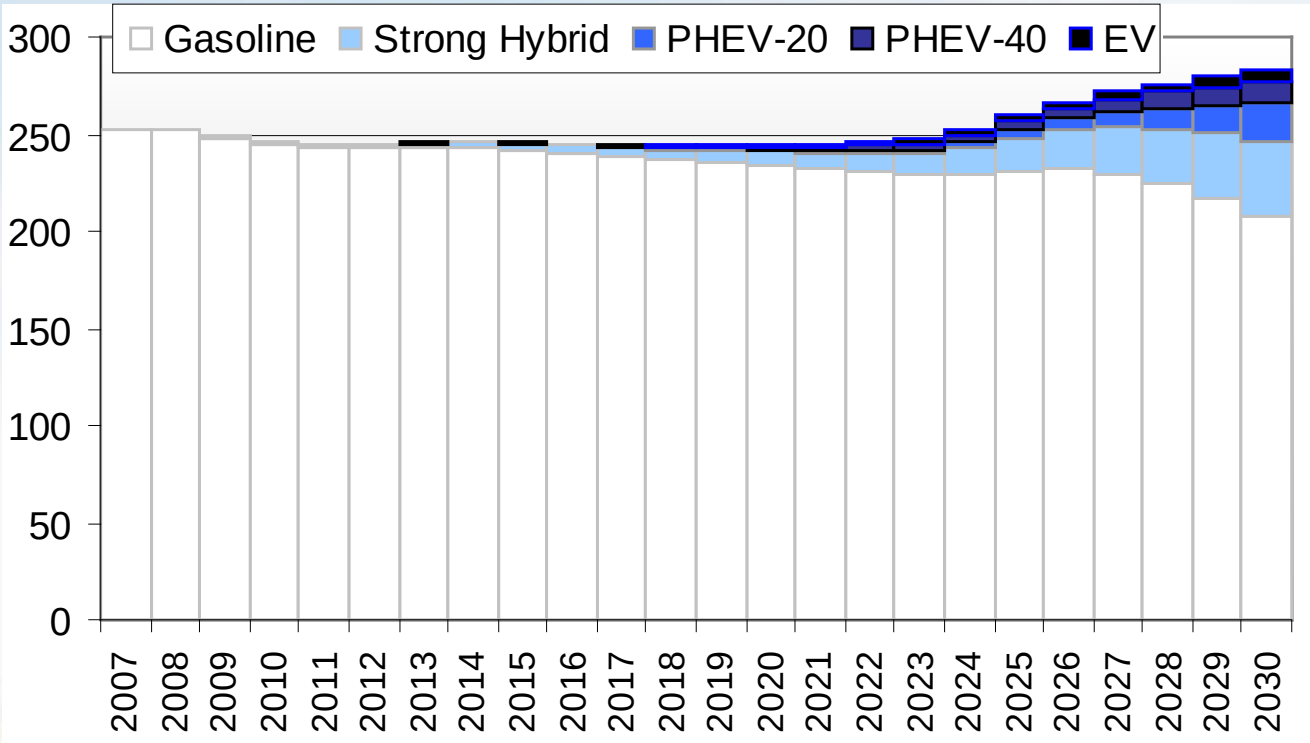
Future Potential of Vehicle Electrification, US Vehicle Fleet: Green Renaissance



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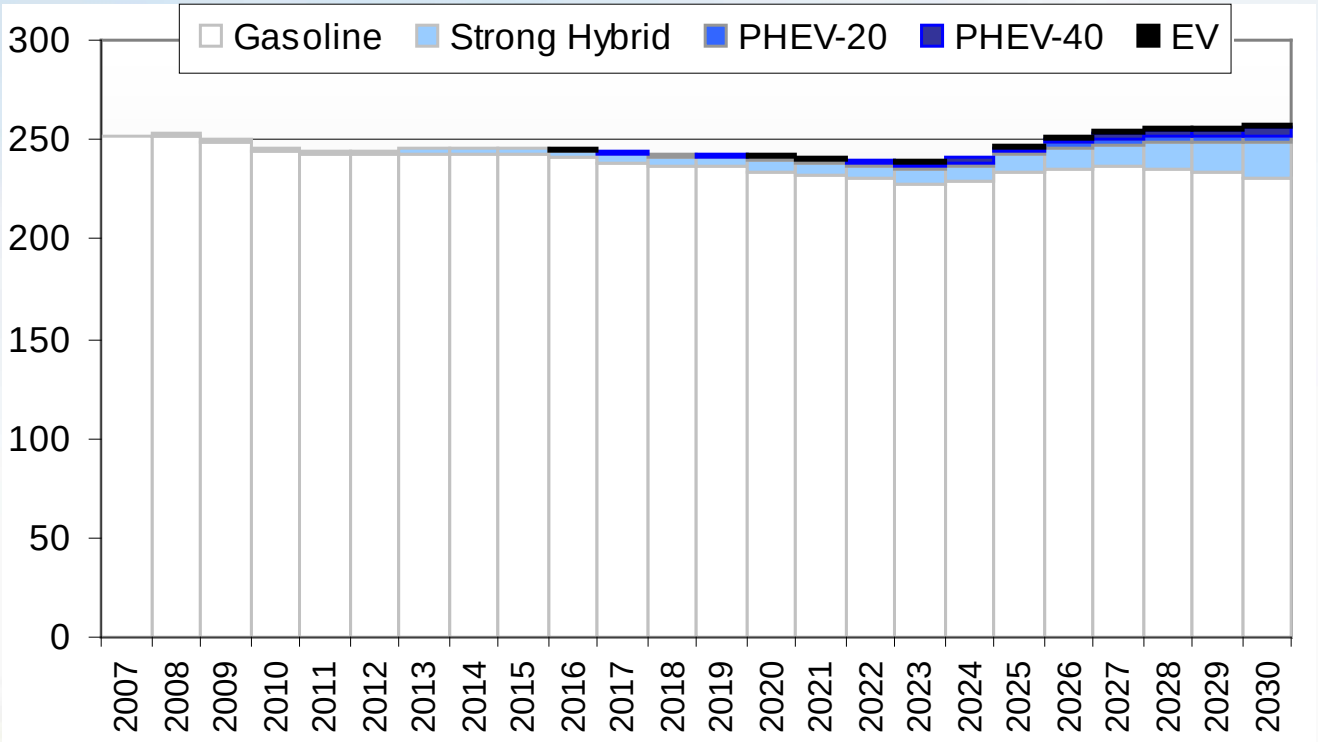
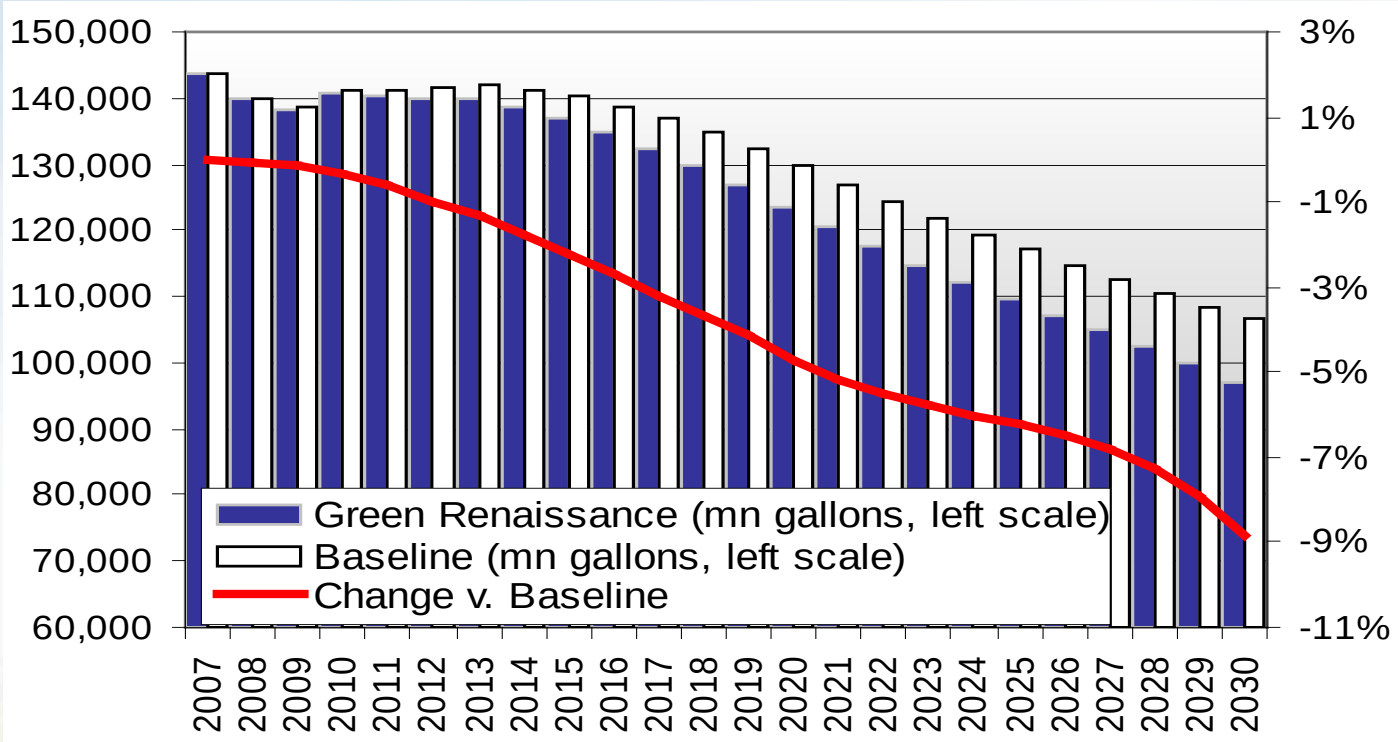


Source: HEC

In "Realpolitik," vehicle electrification penetration is modest. Total light-duty vehicle sales also stagnate.

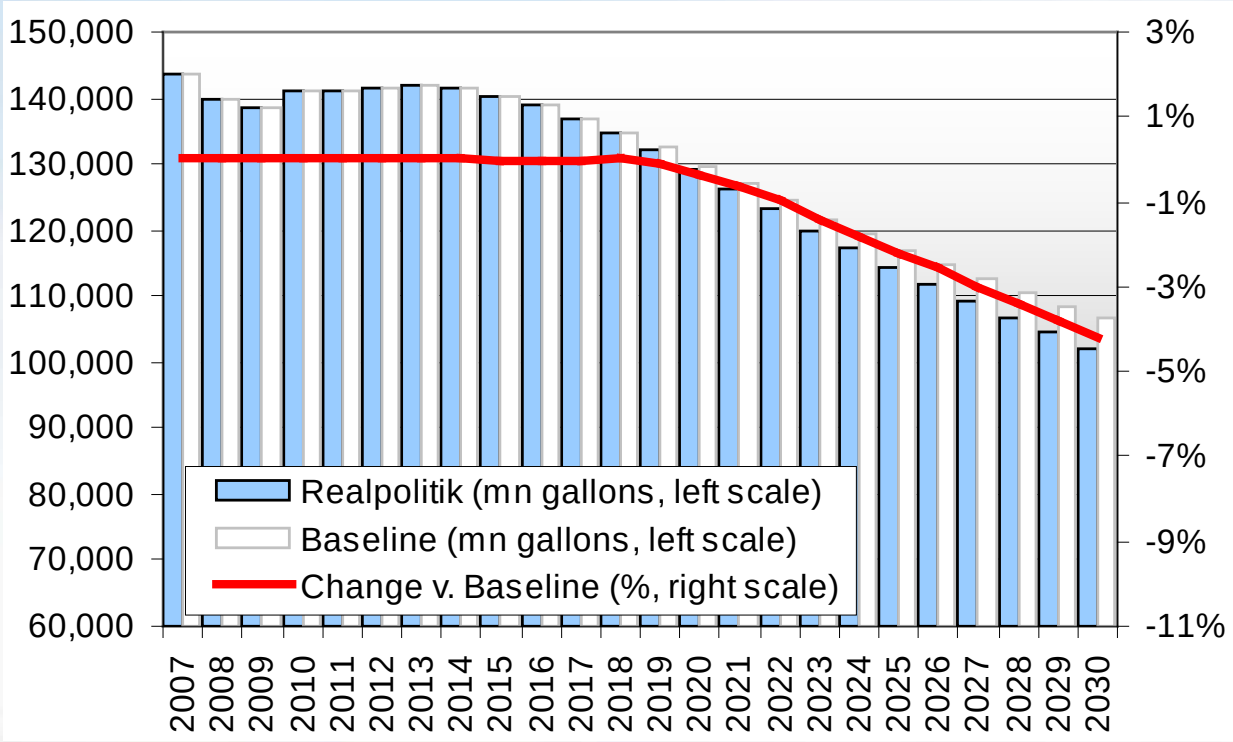
Future Potential of Vehicle Electrification on US Fuel Consumption: Green Renaissance v. Base Case



Source: HEC

In "Green Renaissance," aggressive fuel economy standards & vehicle electrification combine to lower liquid fuels consumption by about 9% compared to the Base Case.

Future Potential of Vehicle Electrification in the US



Source: HEC

In "Realpolitik," liquid fuels consumption also declines relative to the Base Case - mostly because lower new vehicle sales lead to fewer total light-duty vehicles in operation.

Key Takeaways

Vehicle electrification in the US today suffers from high battery costs and relatively low fuel prices, but:

- **Government policies will be necessary to help make HEVs, PHEVs and EVs more affordable until economies of scale push battery costs down further .**
- **Future fuel economy and criteria pollutant emission regulations will make future ICEs more costly.**
- **Vehicle electrification has significant upside—but only after 2020.**
- **Vehicle electrification also depends on the continuation of open trade: resource nationalism and trade barriers could limit OEMs' and battery producers' ability to capitalize on global economies of scale.**

Key Questions Addressed by Our Next Study

- **Impact of US Electrification on Lithium and Rare Earth Elements**
- **Issues Related to Charging Infrastructure and Electricity Generation Needs**
- **Impact of US Electrification on Greenhouse Gas Emissions**

Audience Questions

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