



quarterly **a**nalysis review

14.3&4

3 & 4 Q 2014

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23 feb 2015

topics

1

energy markets

automotive markets

technologies studies

environmental studies

consumer & opinion surveys

policy studies

qar
outline

1 energy markets

petroleum demand

- > FOTW: The transportation petroleum “gap” has nearly disappeared.
- > FOTW: Net imports of petroleum fell to only 33% of U.S. consumption in 2013.
- > FOTW: World petroleum consumption rises despite declines from U.S. and Europe.

petroleum markets

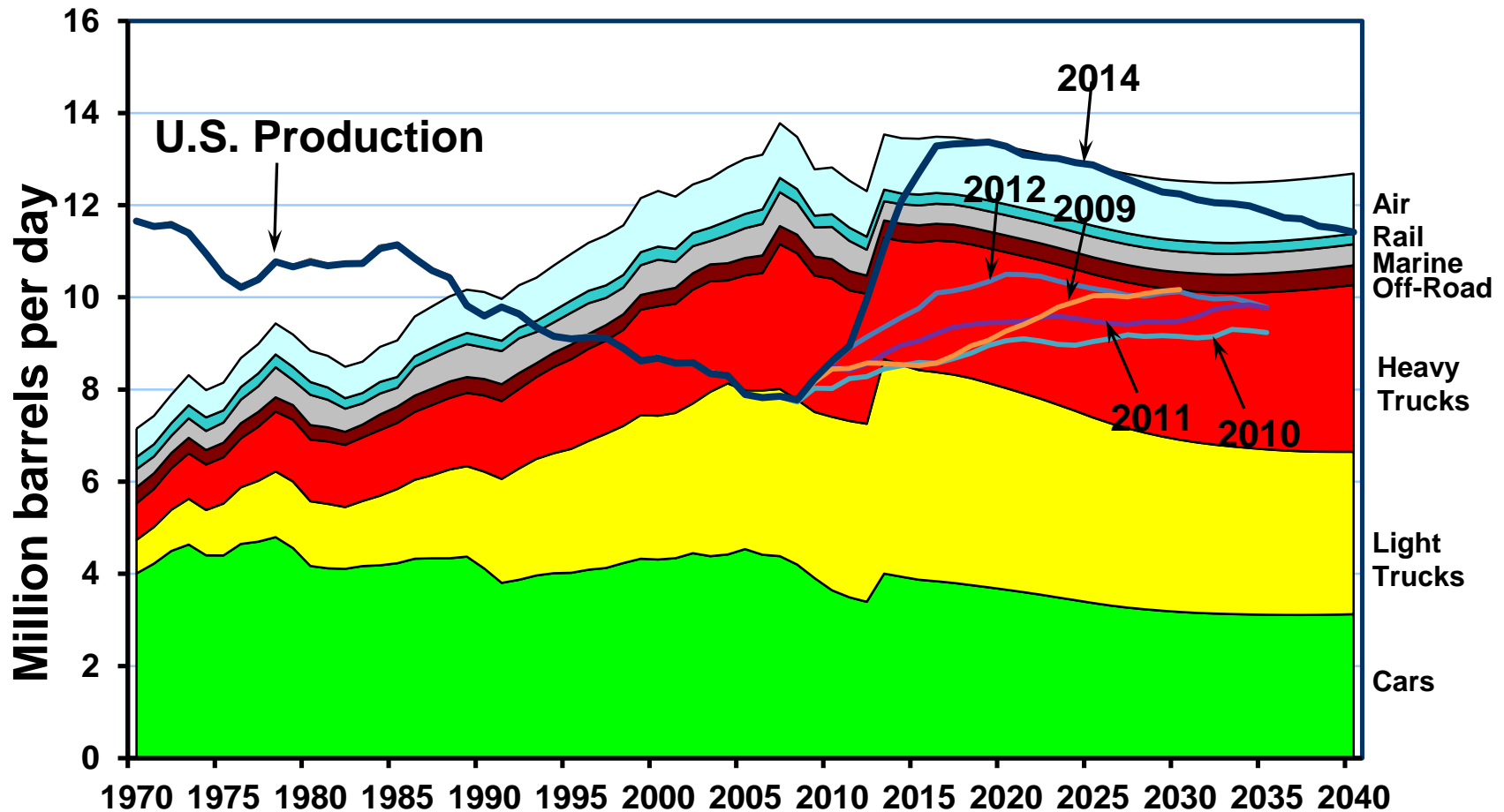
- > ORNL: Lower oil prices and higher GDP growth translate to possible lower oil dependence.
- > FOTW: Non-OPEC countries supply nearly two-thirds of U.S. petroleum imports.
- > ORNL: OPEC’s market power, though “fuzzy”, is indeed correlated to oil price.
- > EIA: Recent growth in US oil production is concentrated in Texas and North Dakota.
- > EIA: Crude oil prices fall sharply in Q4 2014.
- > FOTW: Retail gasoline prices in 2014 experienced the largest decline since 2008.
- > EIA: 20-year trend in oil prices shows that even today’s “low” prices are still relatively high
- > UC-Davis: Breakevens for U.S. shale oil, gas are sensitive to world-market price changes.
- > EIA: U.S. oil production to increase despite expected near-term reduction in rig count.

natural gas markets

- > EIA: Shale gas provides largest share of gas production (even exceeding conventional wells).
- > CBO/EIA: U.S. natural gas production to expand through 2040 (and support net exports).

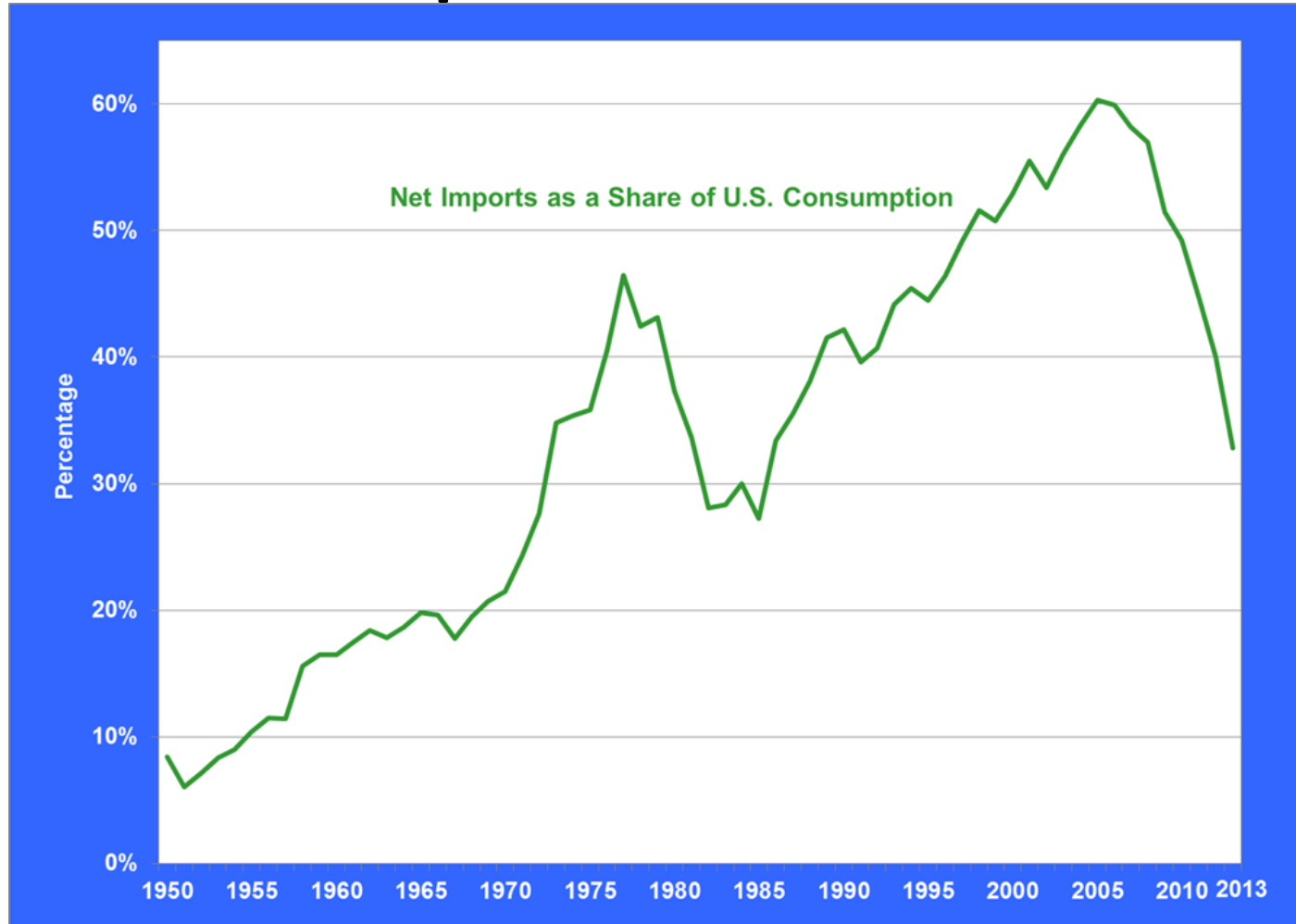
petroleum demand

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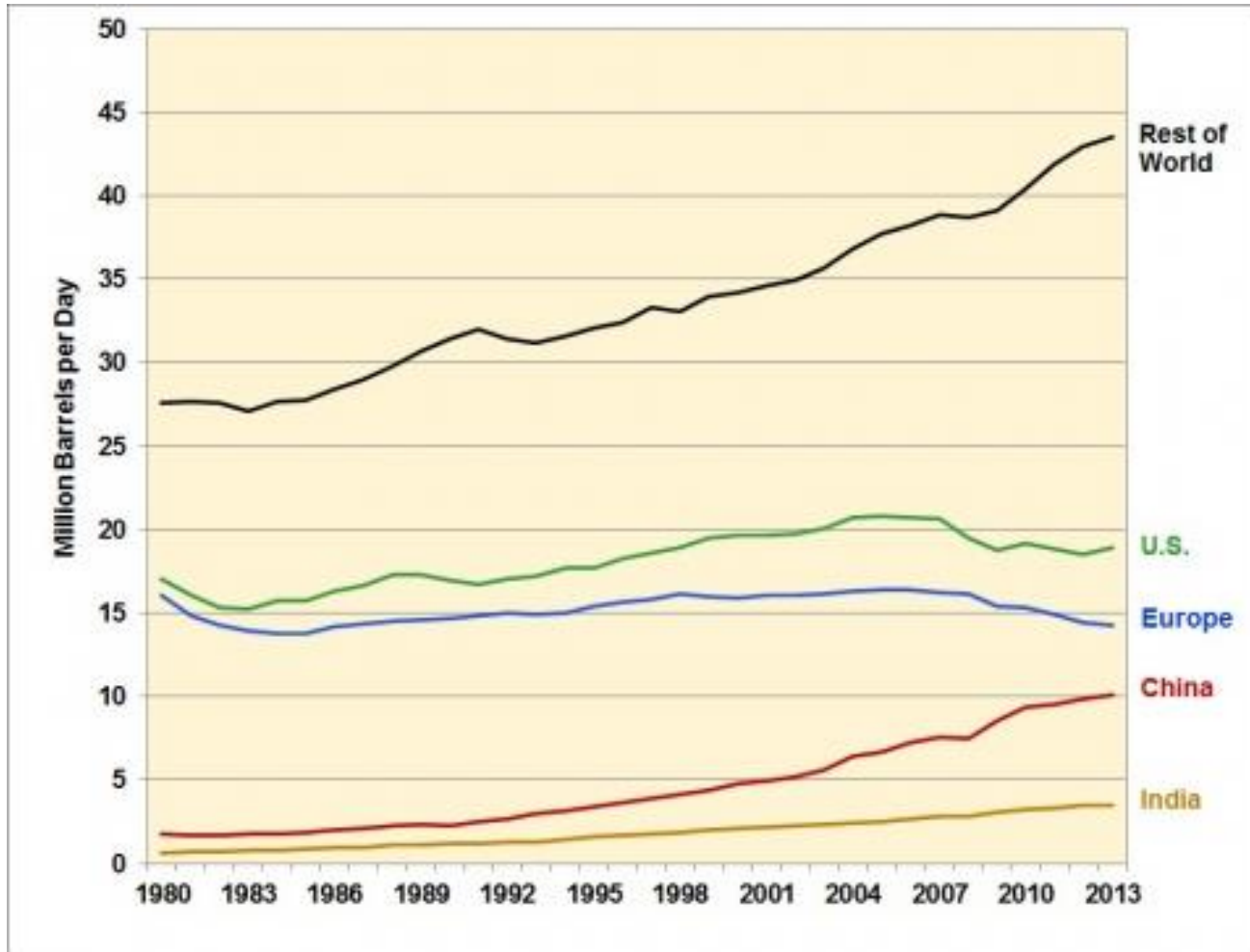
petroleum demand

FOTW: Net imports of petroleum fell to only 33% of U.S. consumption in 2013.



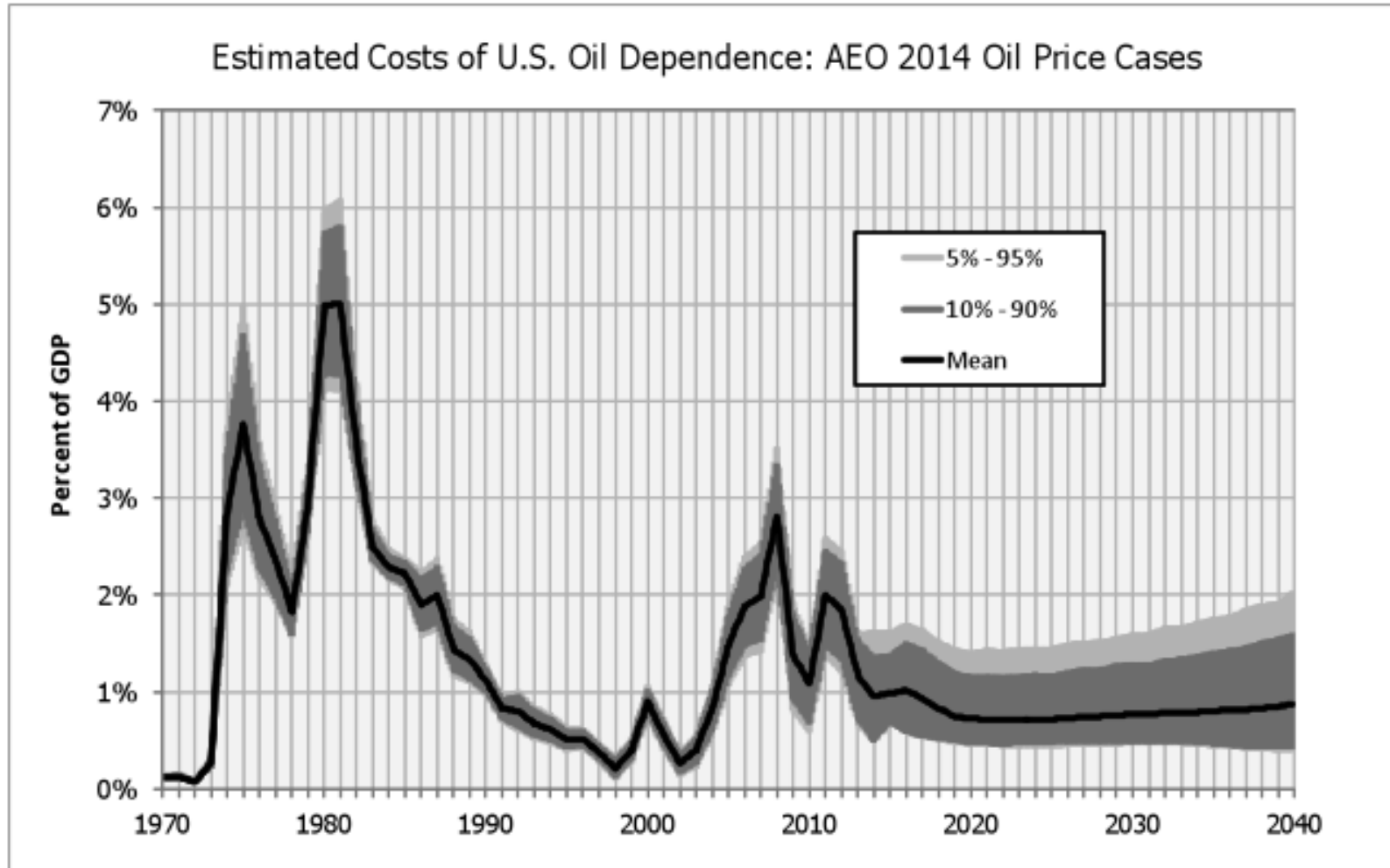
petroleum demand

FOTW: World petroleum consumption continues to rise despite declines from U.S. and Europe



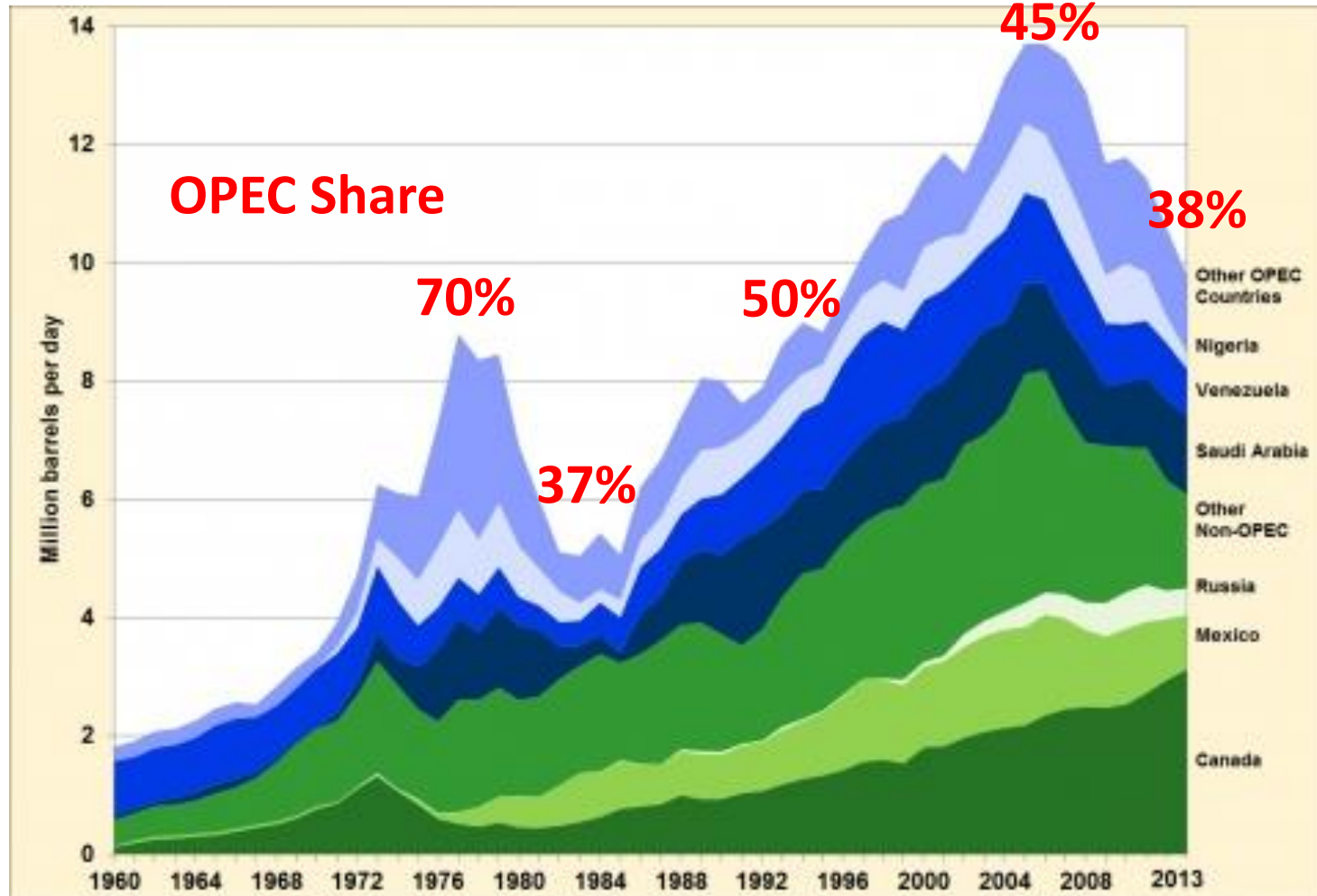
petroleum markets

ORNL: Lower oil prices and higher GDP growth translate to possible lower oil dependence.



petroleum markets

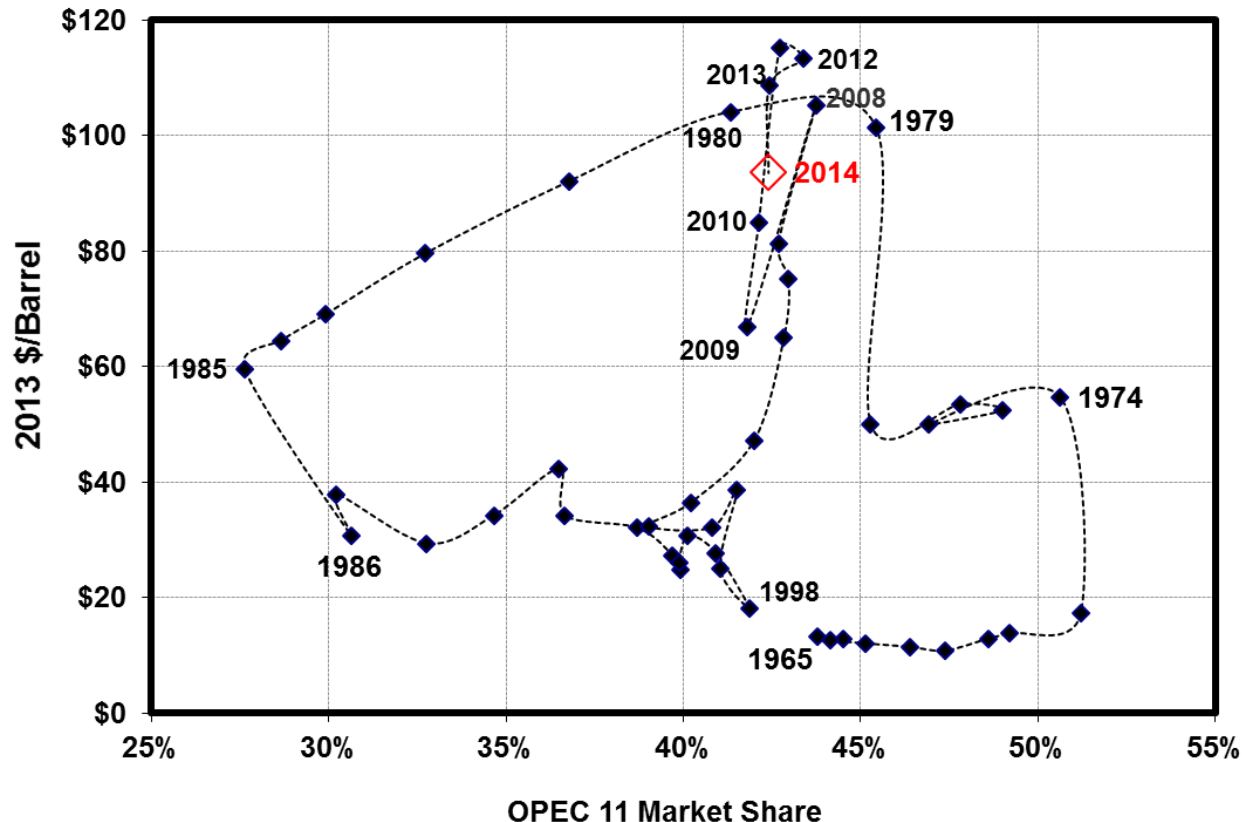
FOTW: Non-OPEC countries supply nearly two-thirds of U.S. petroleum imports.



petroleum markets

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OPEC Market Share and World Oil Prices: 1965-2013



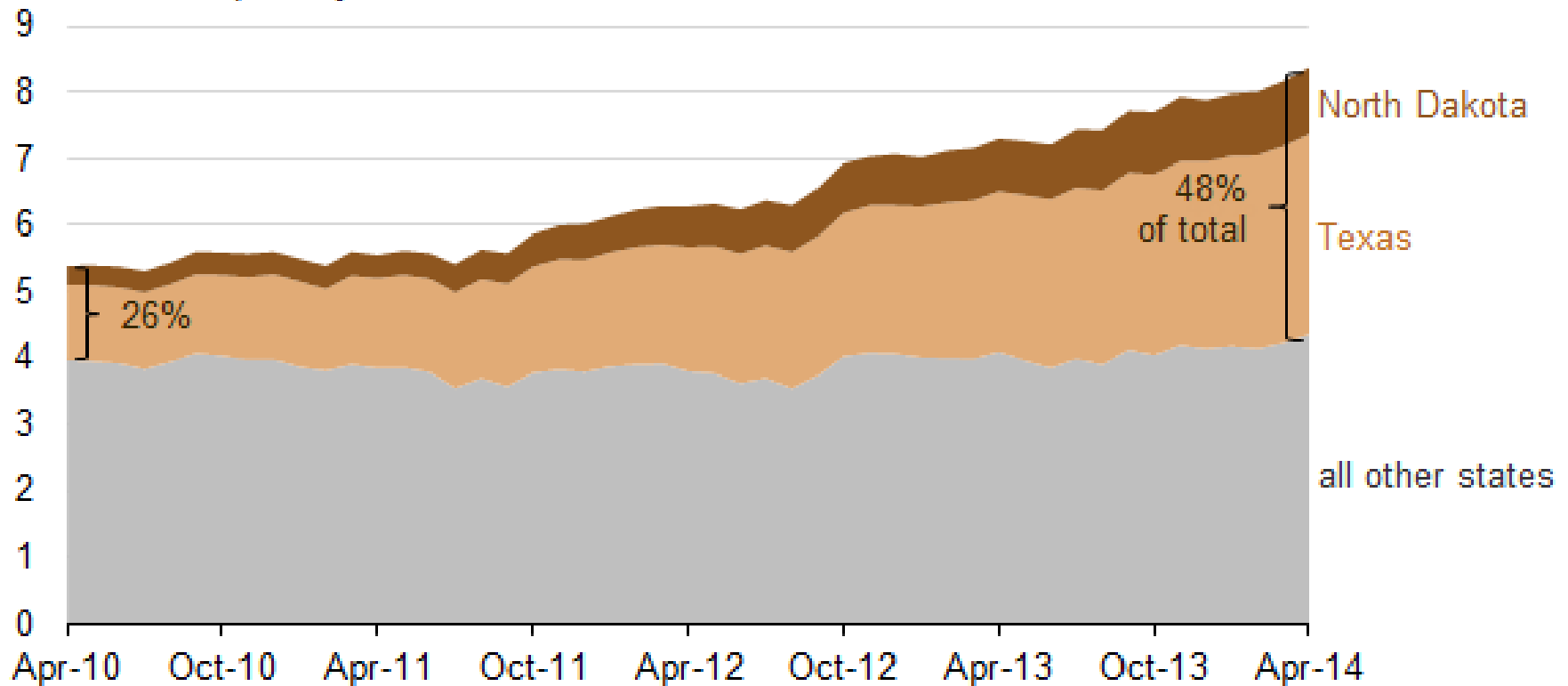
Source: BP Statistical Review of World Energy 2014. "Oil Production - barrels" and "Oil - crude oil prices since 1861".

petroleum markets

EIA: Recent growth in U.S. oil production is concentrated in Texas and North Dakota.

Monthly crude oil production by state (April 2010-April 2014)

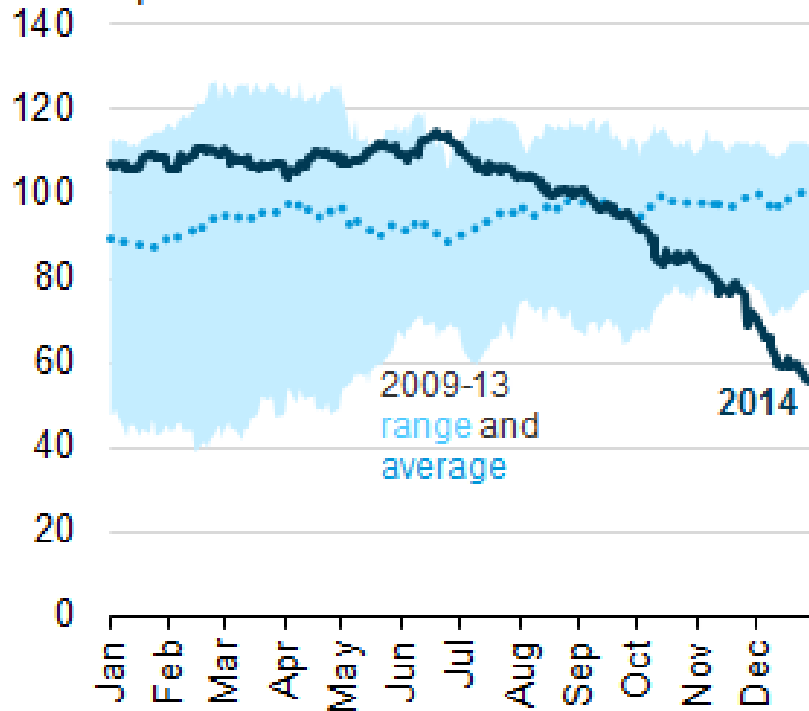
million barrels per day



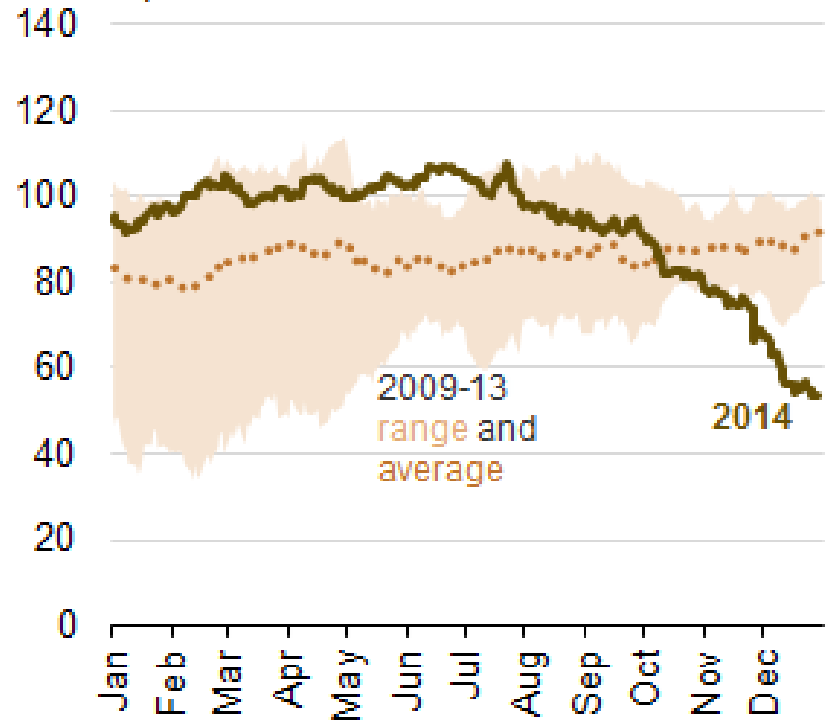
petroleum markets

EIA: Crude oil prices fall sharply in Q4 2014.

Brent crude oil price
dollars per barrel

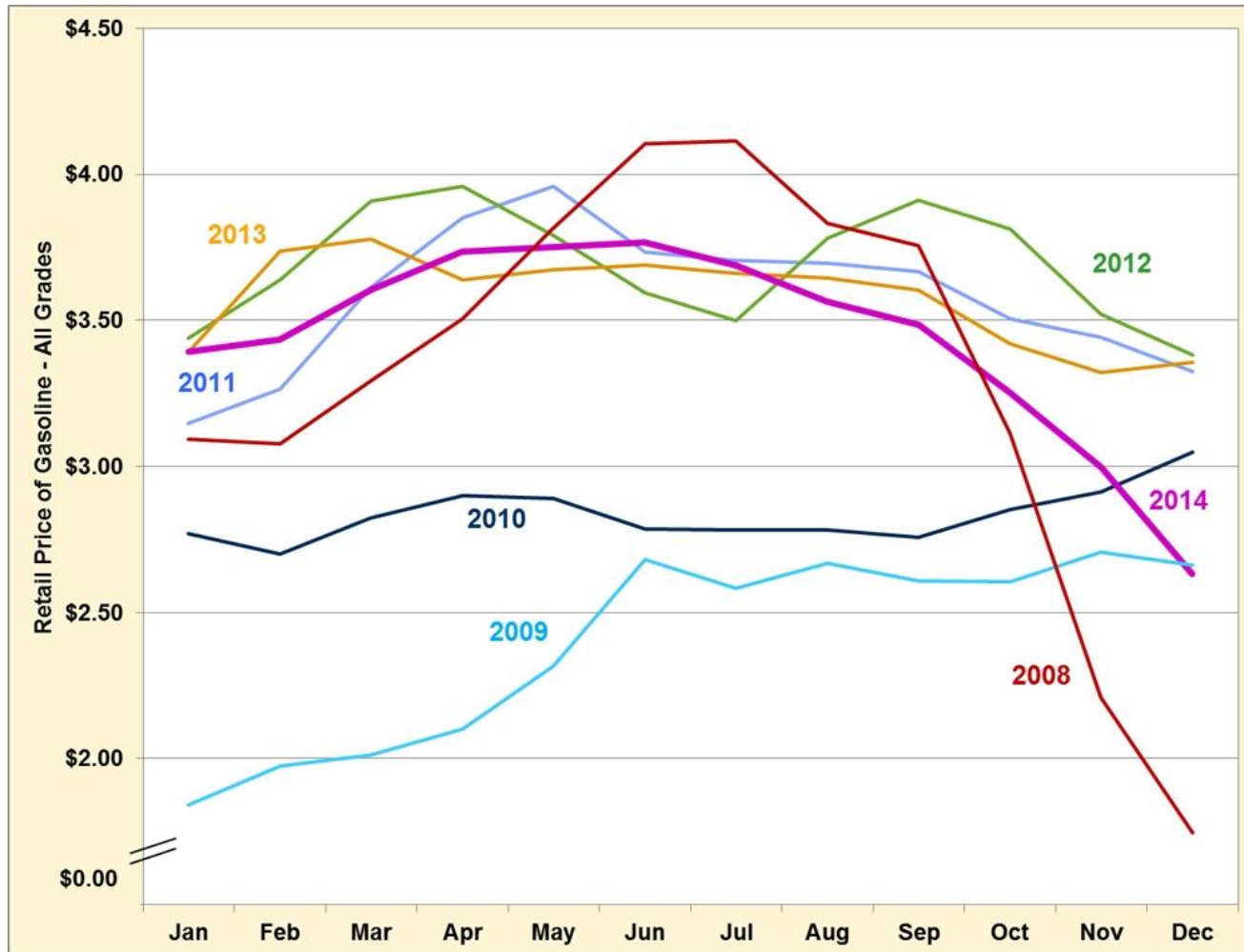


West Texas Intermediate crude oil price
dollars per barrel



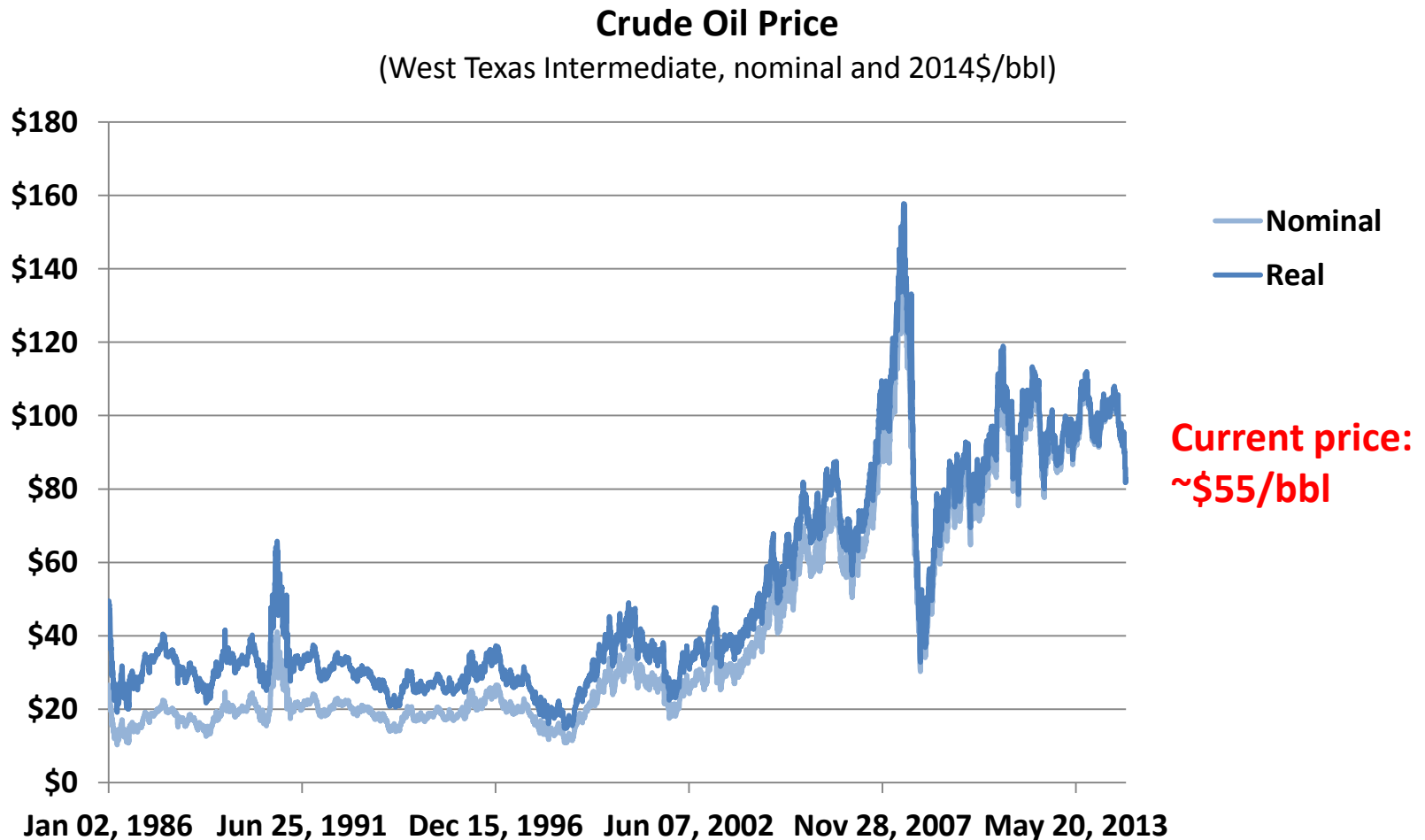
petroleum markets

FOTW: Retail gasoline prices in 2014 experienced the largest decline since 2008.



petroleum markets

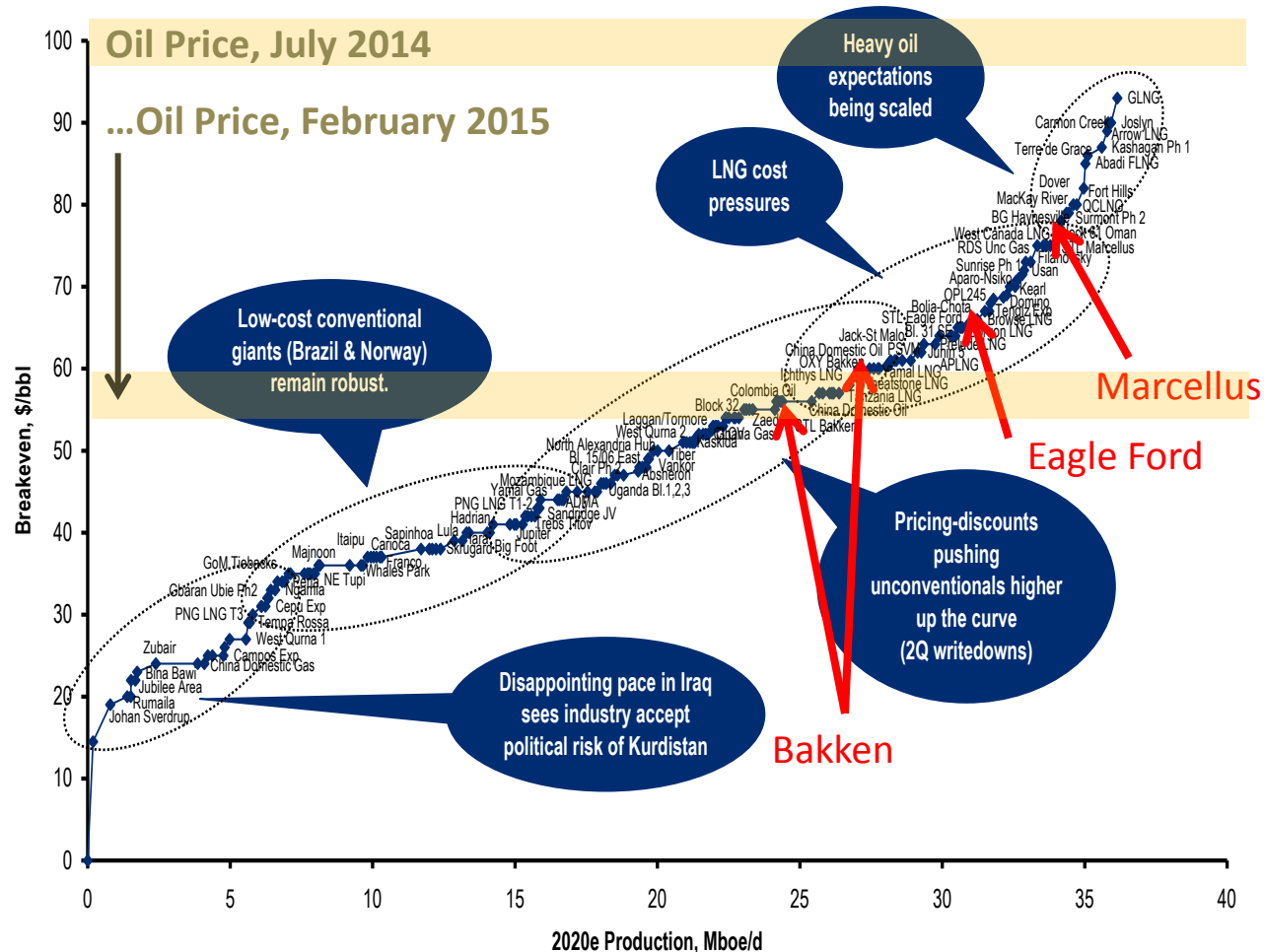
EIA: 20-year trend in crude oil prices shows that even today's "low" prices are still relatively high.



petroleum markets

UC-Davis: Breakevens for U.S. shale oil and gas are sensitive to recent world-market price changes.

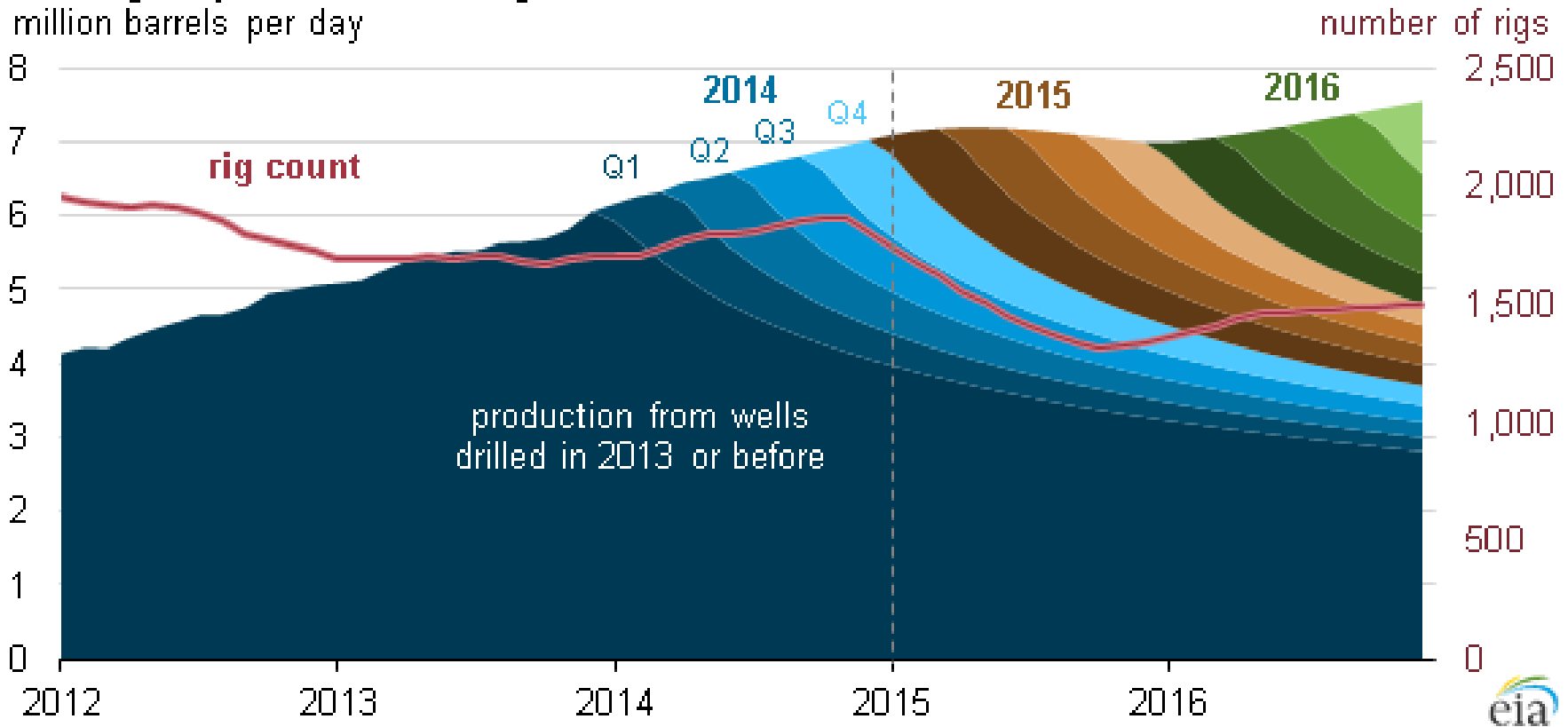
Field	Breakeven	OPEX
Marcellus (gas)	\$2.50	\$1.00
Barnett (gas)	\$3.80	\$1.80
Haynesville (gas)	\$3.60	\$1.80
Eagle Ford (oil)	\$37	\$7-\$8
Permian (oil)	\$49	\$10-\$12
Bakken (oil)	\$37	\$7-\$8
Mississippian	\$43	\$7-\$8



petroleum markets

EIA: U.S. oil production to increase despite expected near-term reduction in rig count.

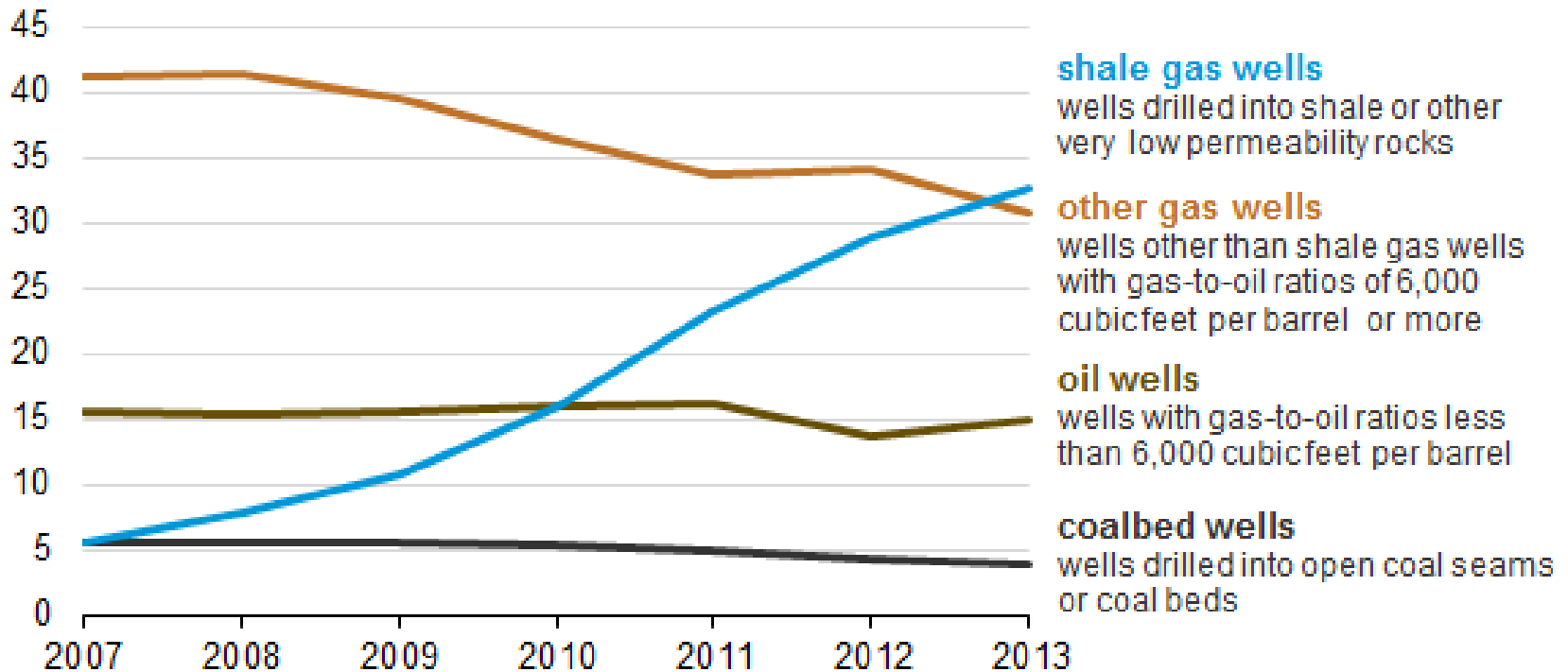
Monthly oil production and rig count in the Lower 48 states, 2012-16



natural gas markets

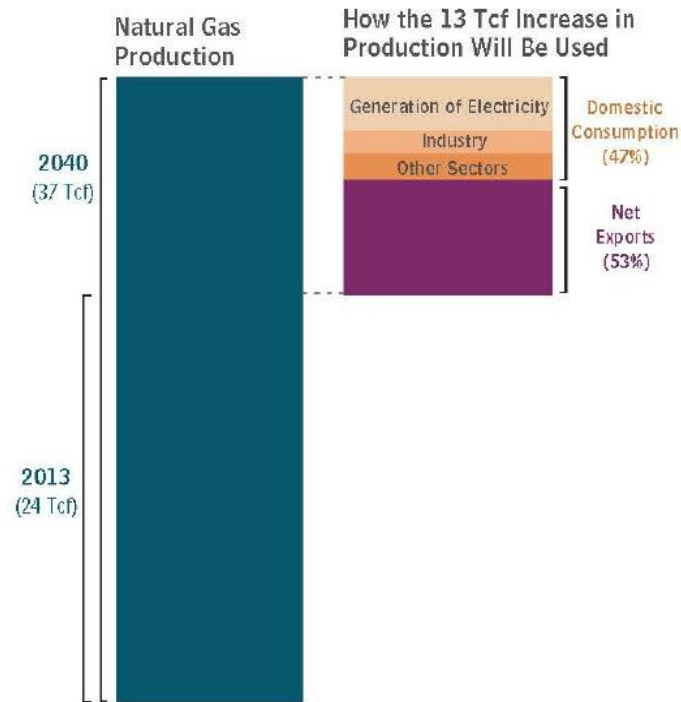
EIA: Shale gas provides largest share of gas production (now even exceeding conventional wells).

U.S. natural gas gross withdrawals by well type (2007-13)
billion cubic feet per day



natural gas markets

CBO/EIA: U.S. natural gas production to expand through 2040 (and support net exports).



Source: Congressional Budget Office based on data from the Energy Information Administration, *Annual Energy Outlook 2014 With Projections to 2040*, DOE/EIA-0383(2014) (April 2014), <http://go.usa.gov/8KyF> (PDF, 12 MB).

Note: Tcf = trillion cubic feet.

topics

energy markets

2 automotive markets

technologies studies

environmental studies

consumers/opinion surveys

policy studies

qar
outline

2 automotive markets

vehicle sales

- > ANL: LDV sales reached record high in May 2014, suggesting the market has rebounded.
- > FOTW: ANL: Cumulative PEV sales continue to outpace HEV sales in first 50 months since market intro.
- > ANL: PEVs comprise more model availability; volume leaders remain the same.
- > ANL: NEV (xEV+FCV) share of car production in China reaches 0.35% in 2014.
- > ANL: PEV sales in Europe up >50% from 2013, with 58,582 units sold.
- > EPIA: EV sales trends mirror those of gas prices.

vehicle trends

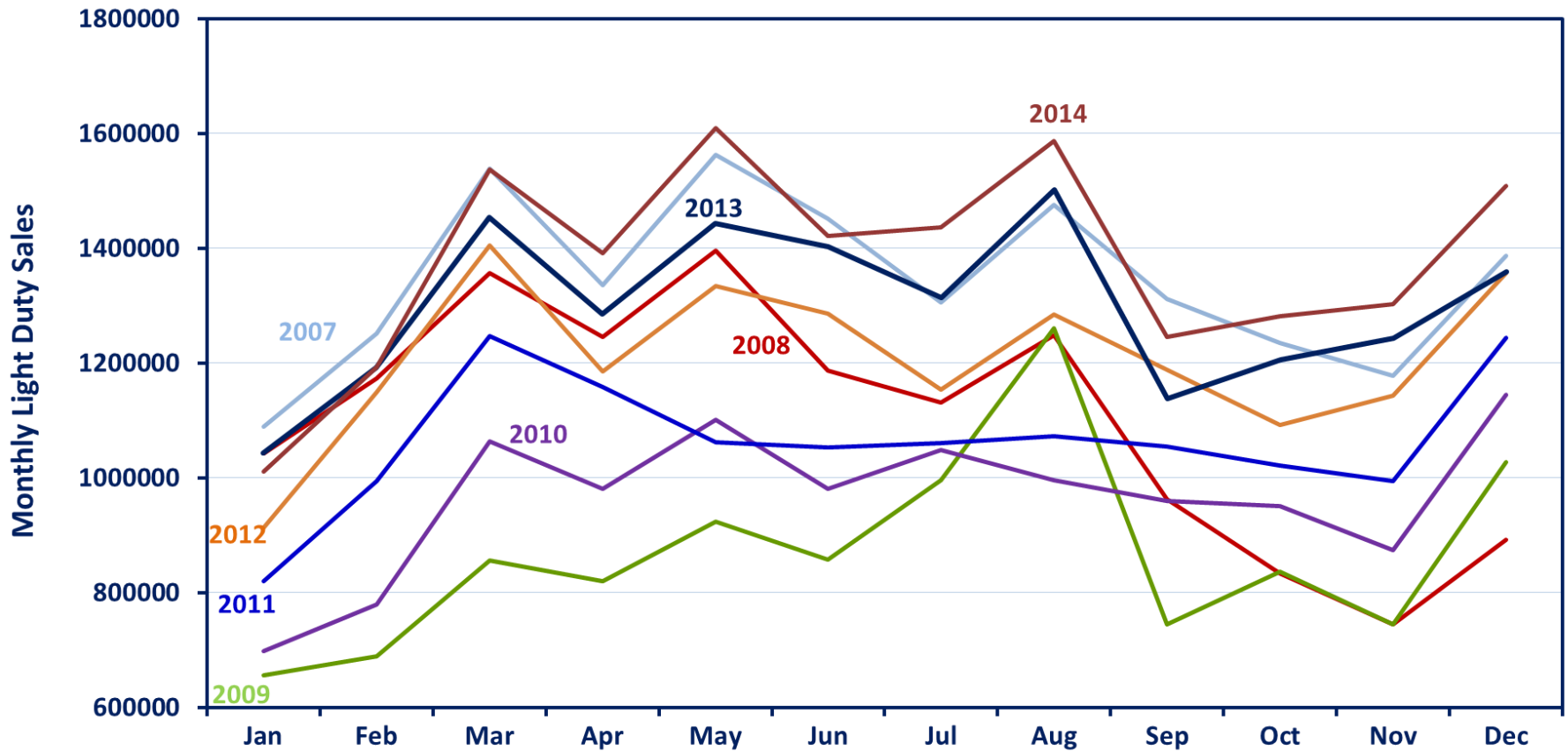
- > FOTW: Vehicles and vehicle travel trends have changed (for the long-term?) since 2008.
- > FOTW: Motorization in China is accelerating, but not (yet?) as fast as in early 20th Century U.S.
- > FOTW: About two-thirds of transportation energy use is gasoline for light vehicles.

transportation trends

- > DOT: 2010 freight flows by highway, railroad, and waterway.

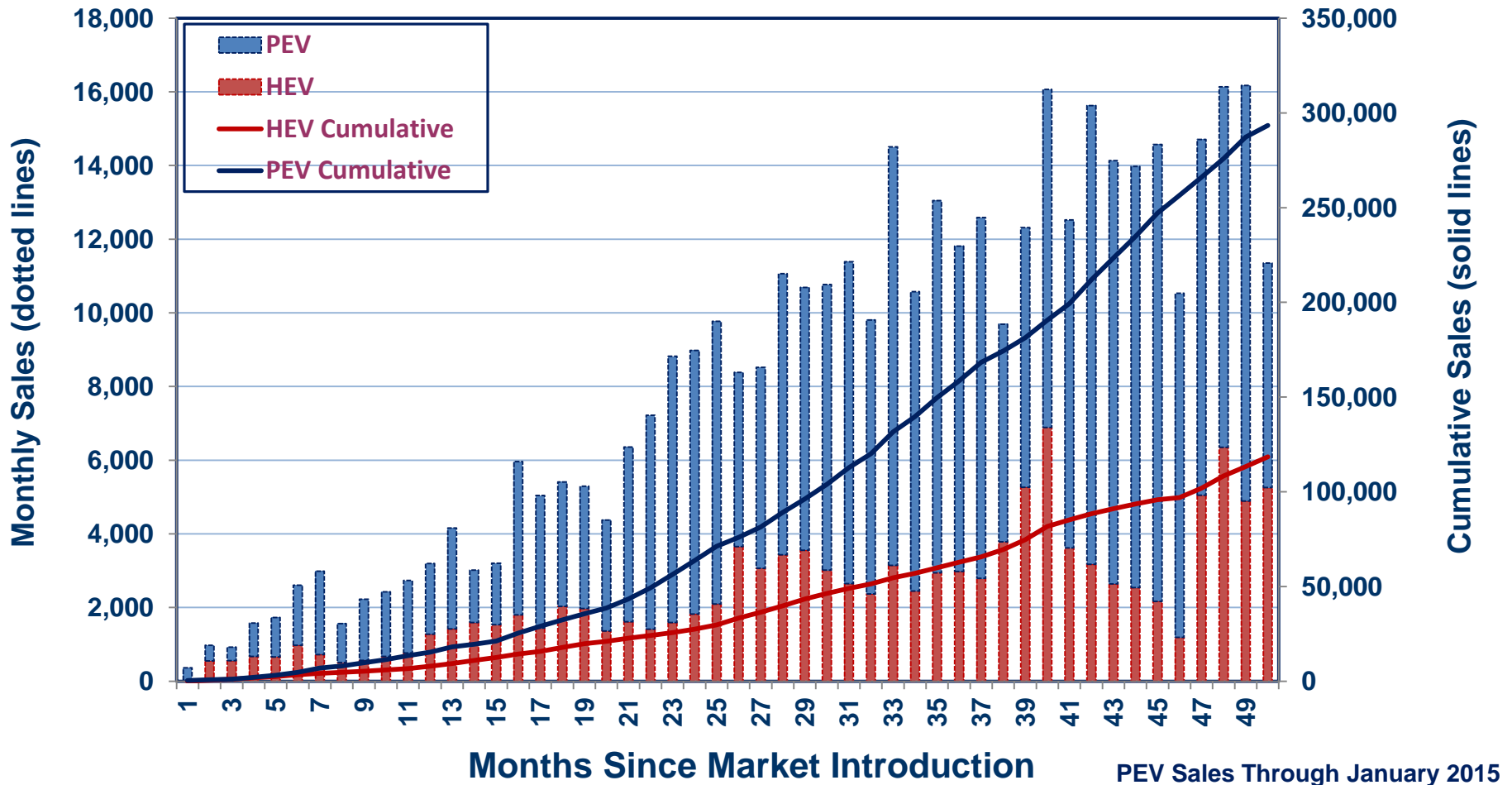
vehicle sales

ANL: LDV sales reached record high in May 2014, suggesting the market has fully rebounded.



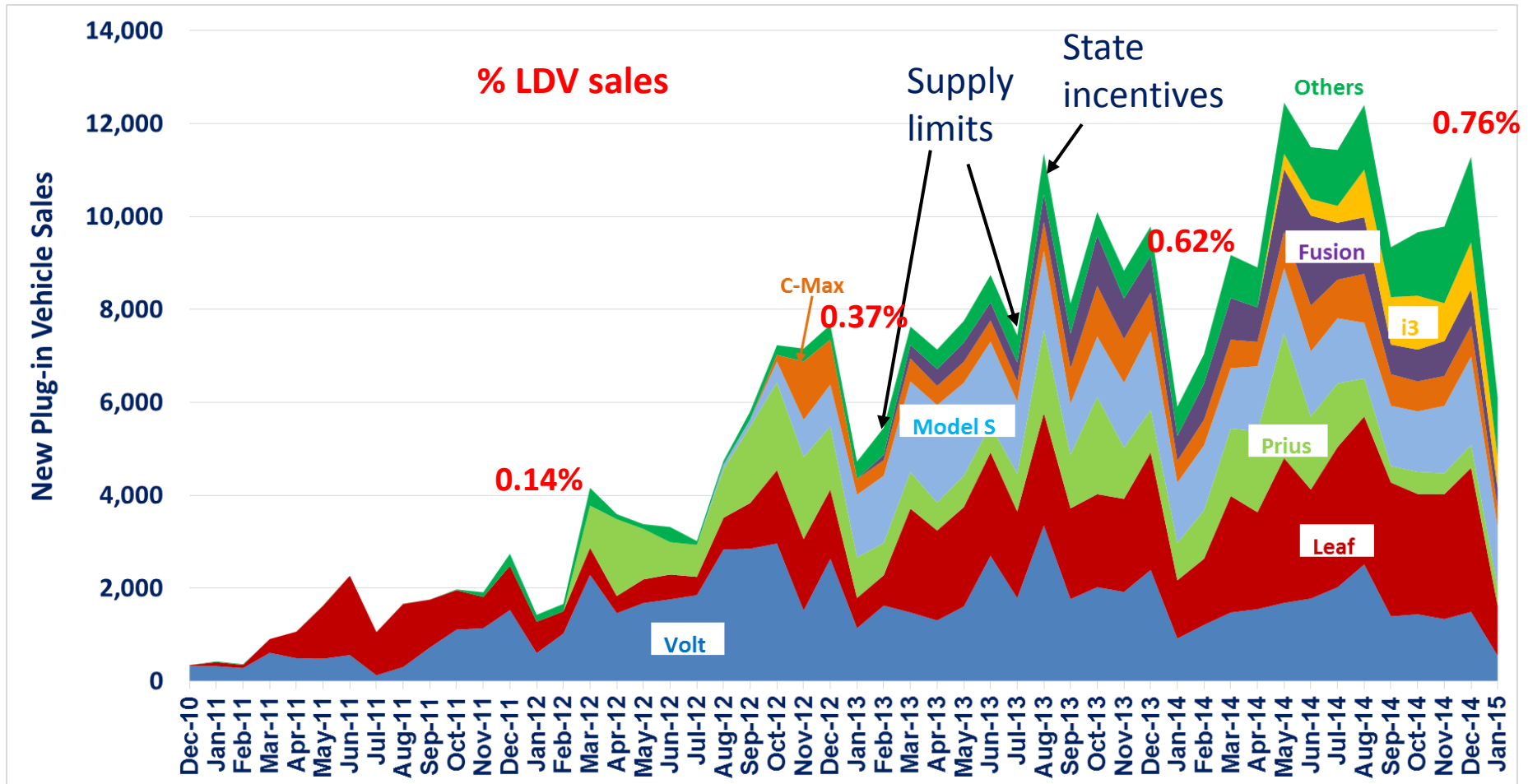
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vehicle sales

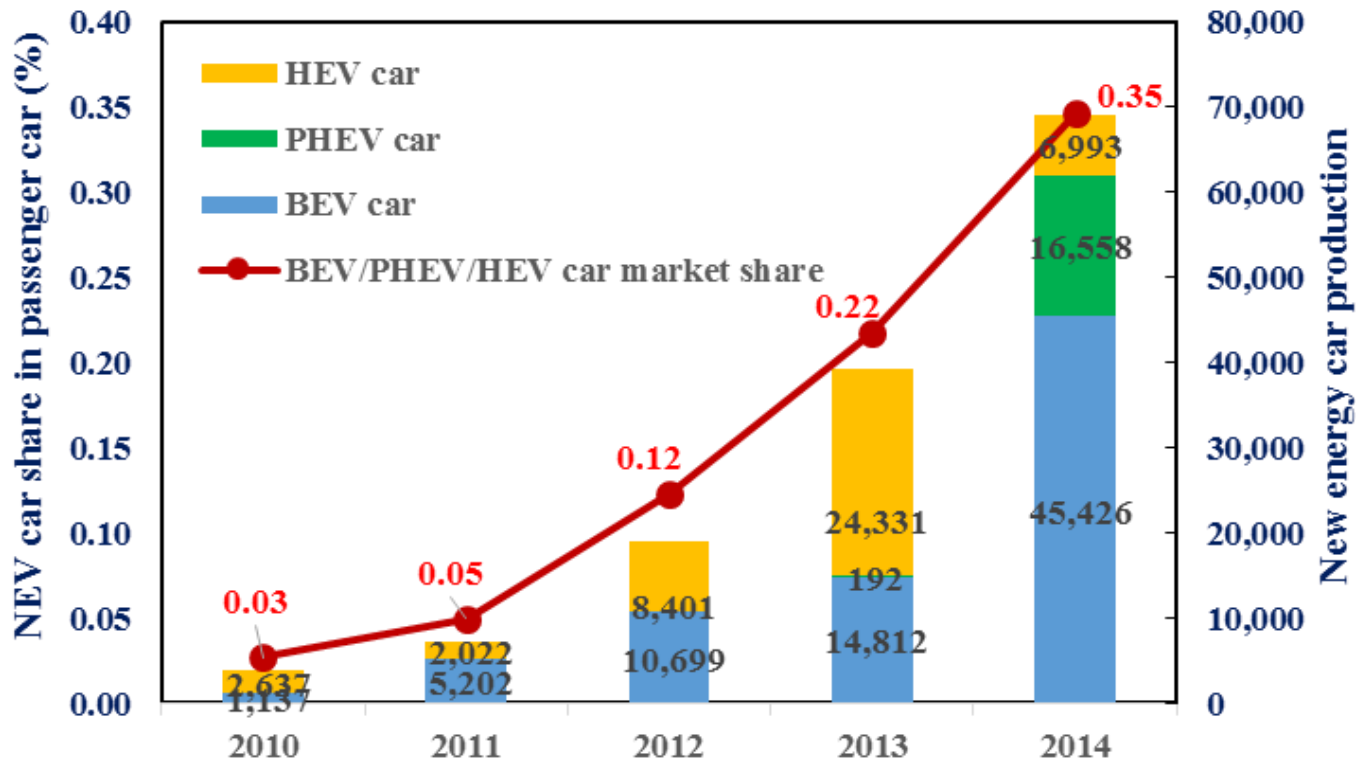
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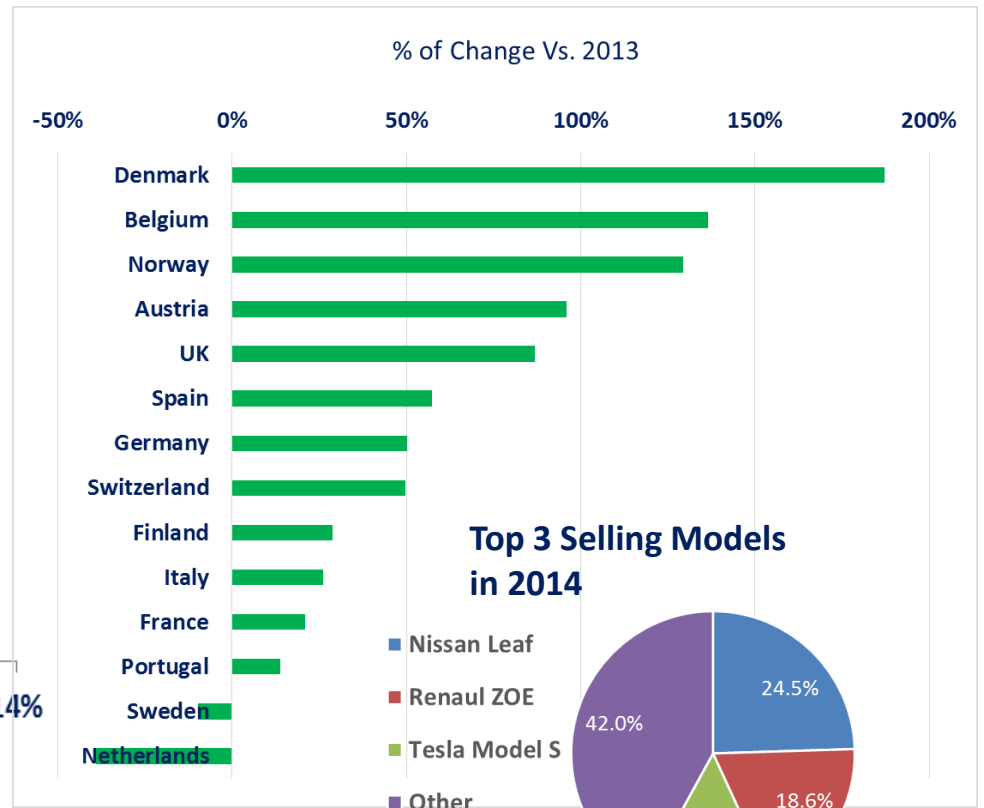
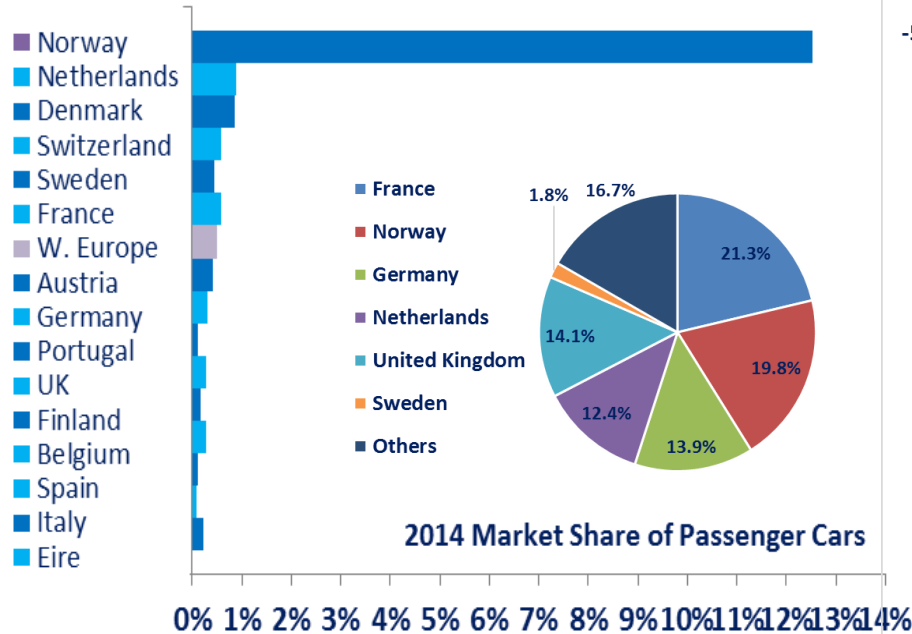
China NEV car production and market share



New energy vehicle in China includes HEV, PHEV, BEV, FCV

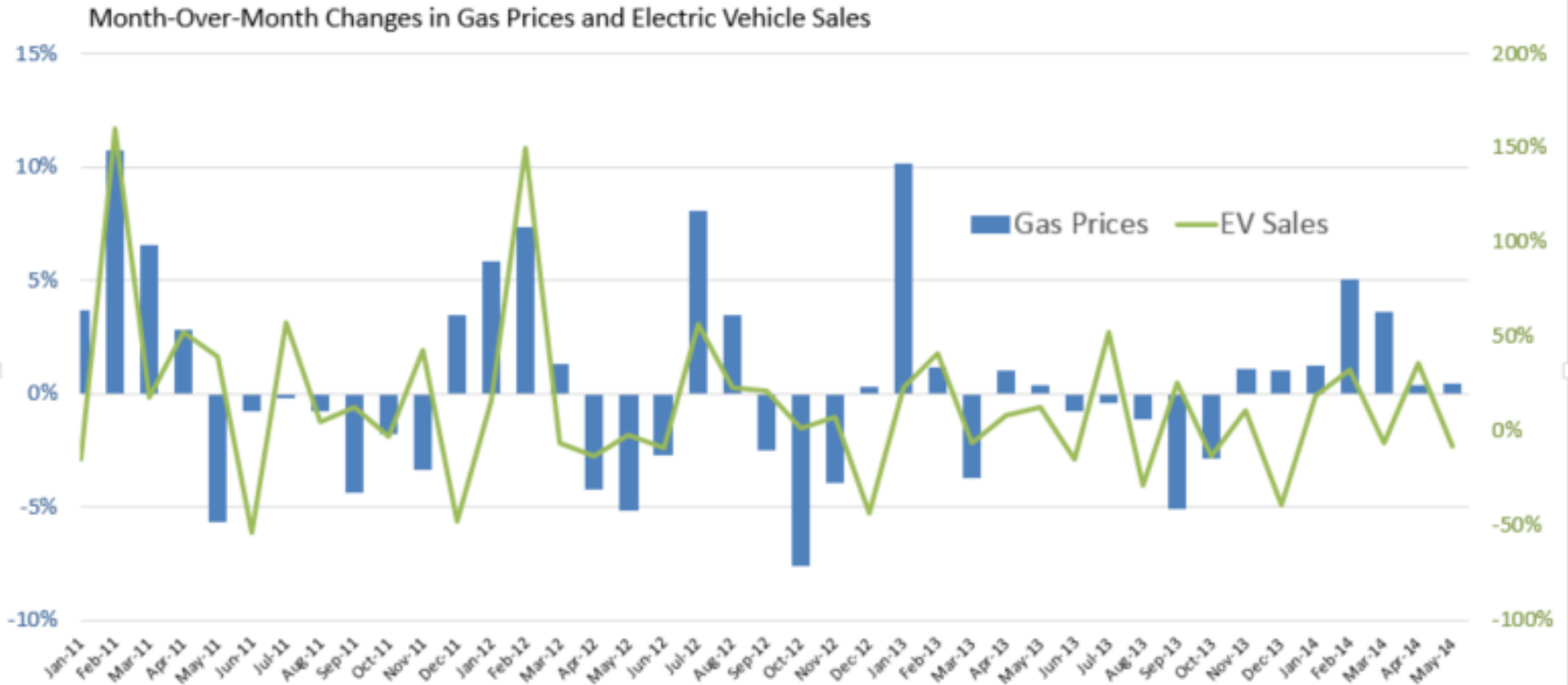
vehicle sales

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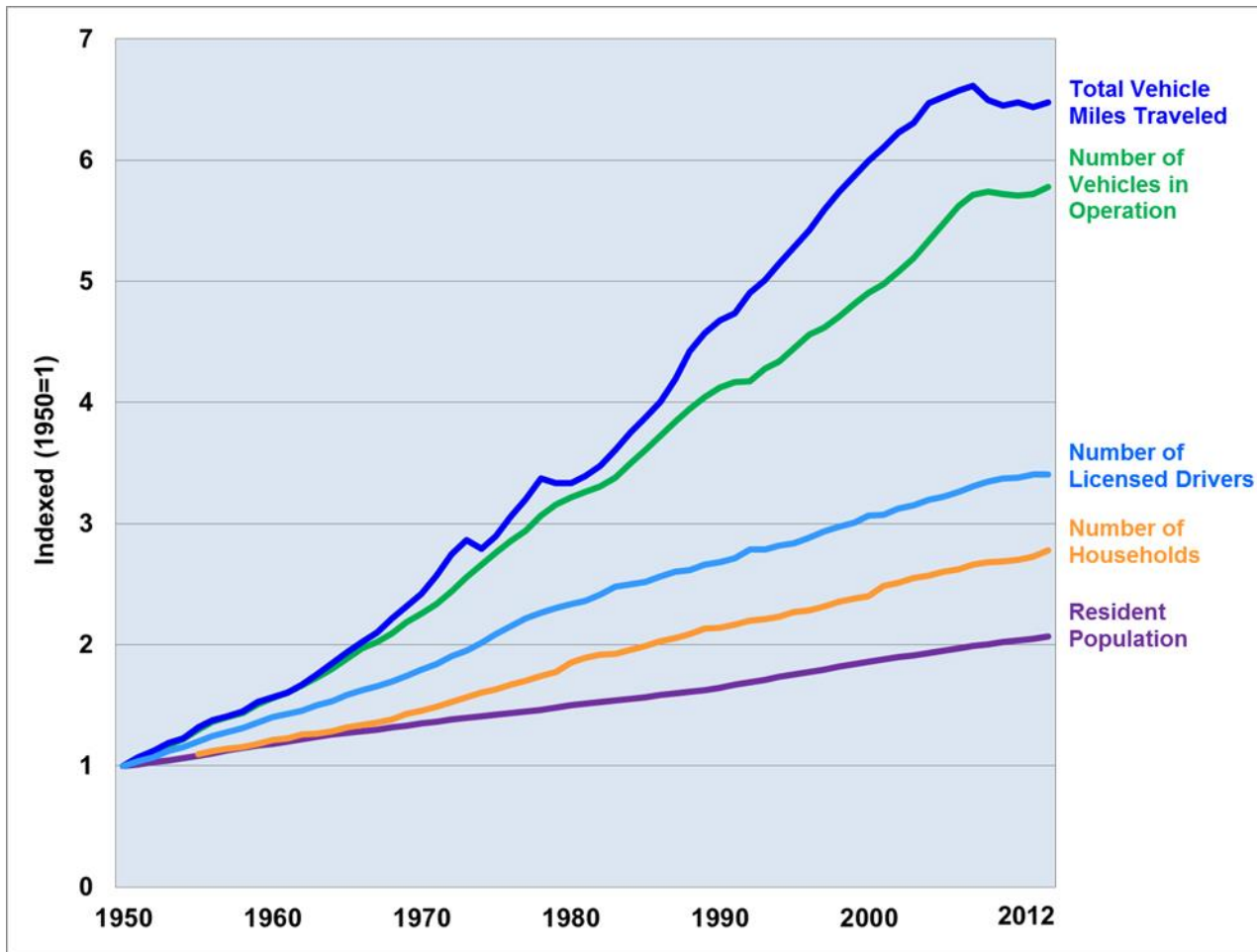
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EPIA: EV sales trends mirror those of gas prices.



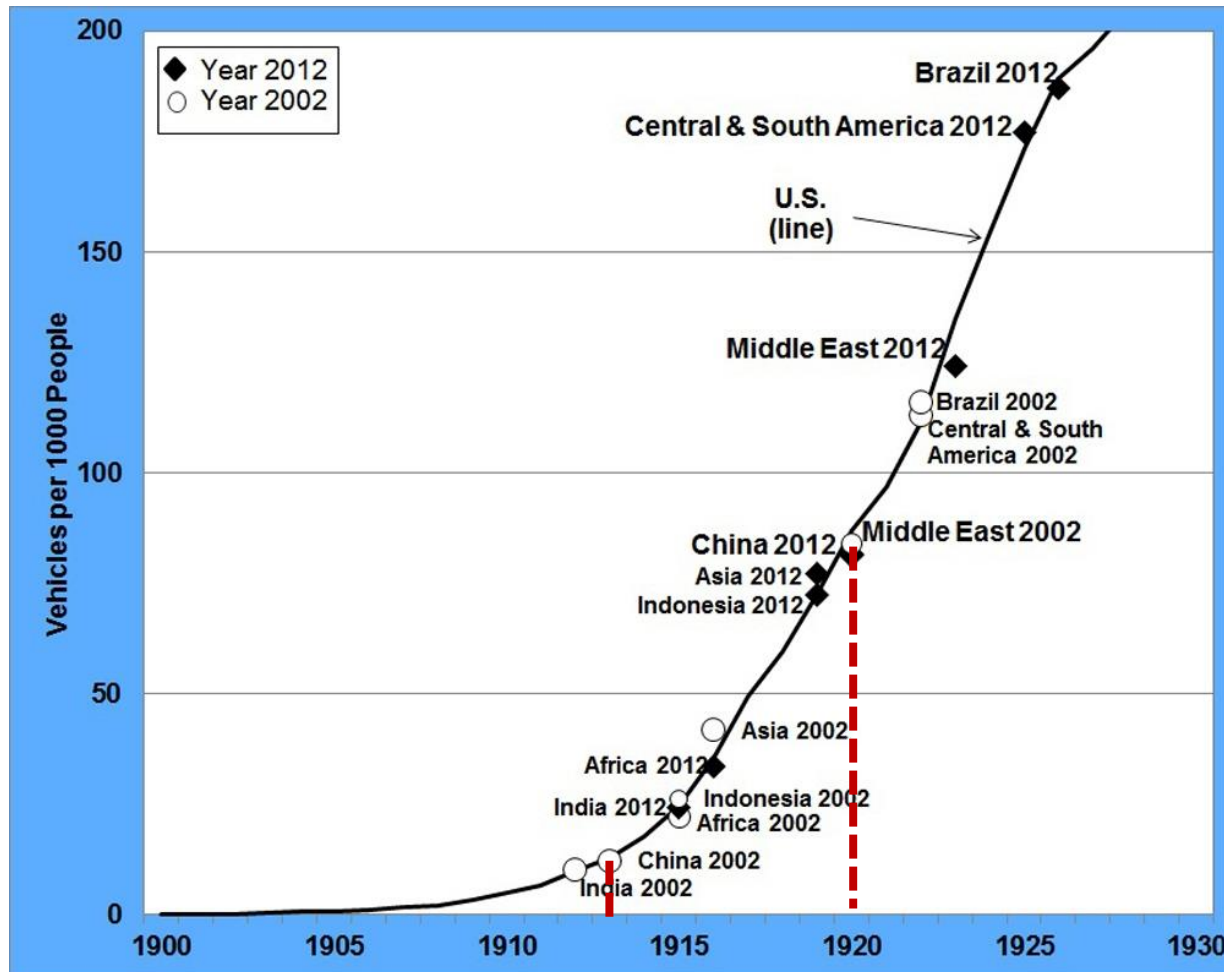
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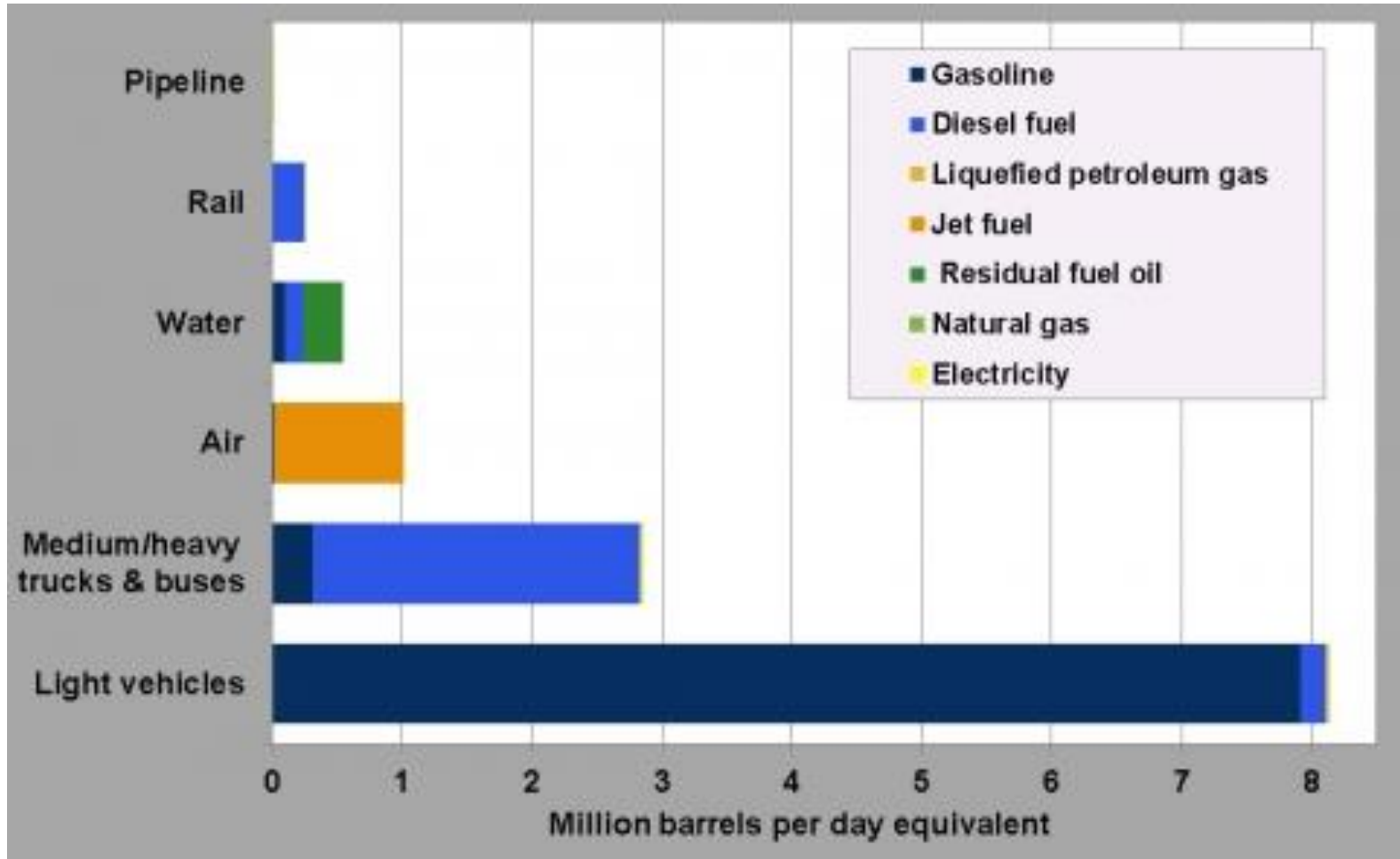


Motorization rate in China grew in 10 years (2002-2012) the same amount U.S. motorization grew in only 7 years, one century earlier (1912-1920).

(Though, different market size should be considered.)

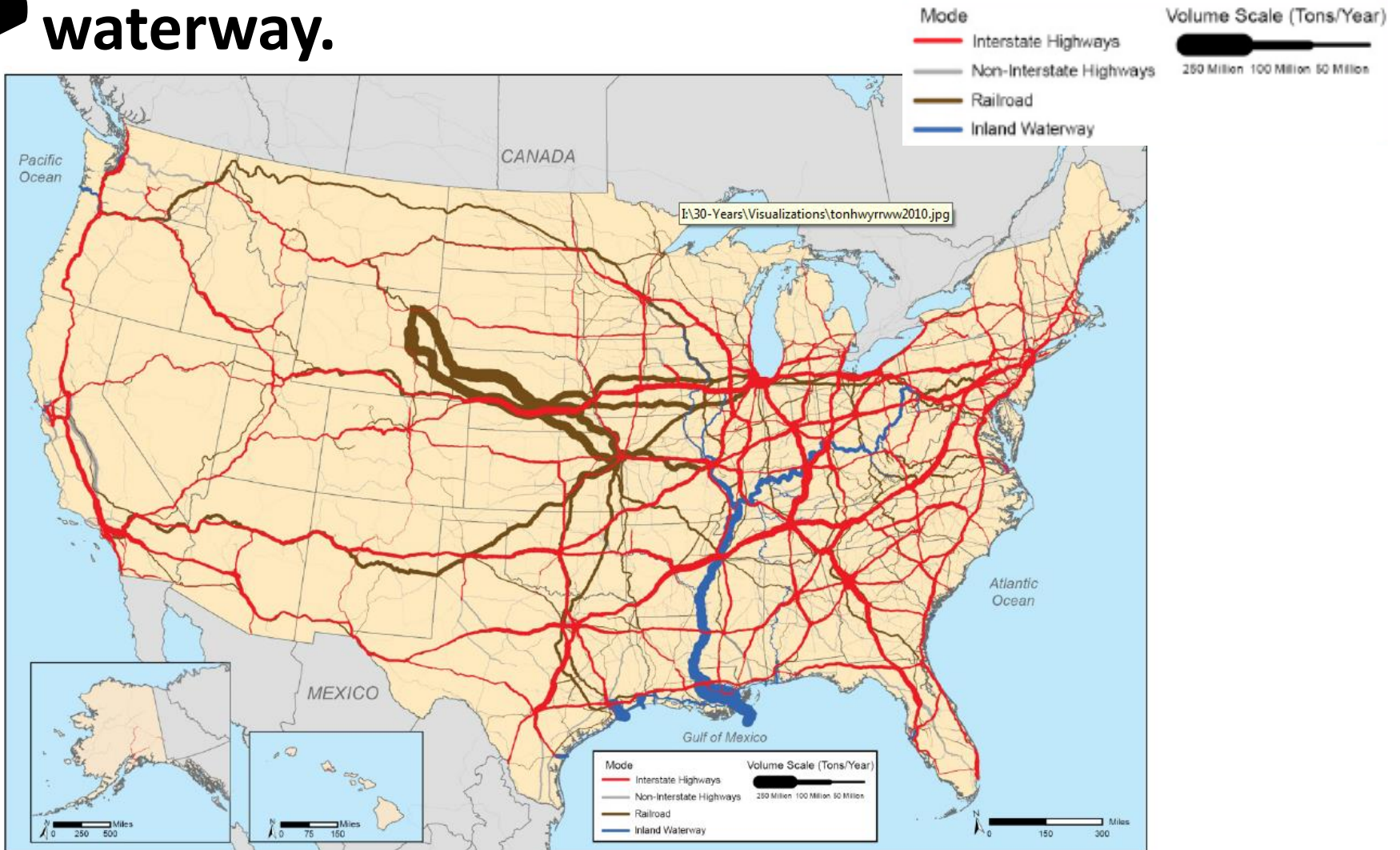
vehicle trends

FOTW: About two-thirds of transportation energy use is gasoline for light vehicles.



transportation trends

DOT: 2010 freight flows by highway, railroad, and waterway.



Sources: **Highways:** U.S. Department of Transportation, Federal Highway Administration, *Freight Analysis Framework*, Version 3.4, 2013; **Rail:** Based on Surface Transportation Board, Annual Carload Waybill Sample and rail freight flow assignments done by Oak Ridge National Laboratory; **Inland Waterways:** U.S. Army Corps of Engineers, Institute of Water Resources, Annual Vessel Operating Activity and Lock Performance Monitoring System data, 2013.

topics

energy markets

automotive markets

3 technologies studies

environmental studies

consumers/opinion surveys

policy studies

qar
outline

3 technologies studies

vehicle technology

- > EPA: Advanced technology and alternative fuel vehicle models increased through MY 2014.
- > EPA: Stop/start technology is in ~5% of all new light vehicles produced.

ev infrastructure

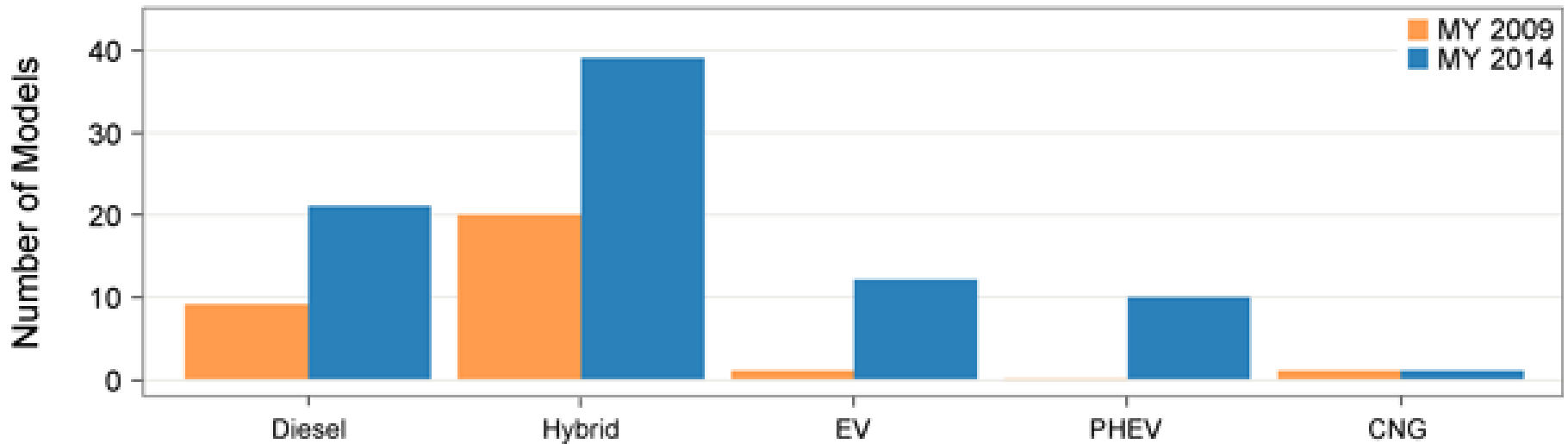
- > FOTW/AFDC: EVSE network providers can differ greatly geographically.

ev range

- > FOTW: Driving ranges for all-electric vehicles in MY2014 vary (from 62 to 265 miles).
- > ORNL/FleetCarma: EV efficiency (and, therefore, range) uncertainty a potential concern?

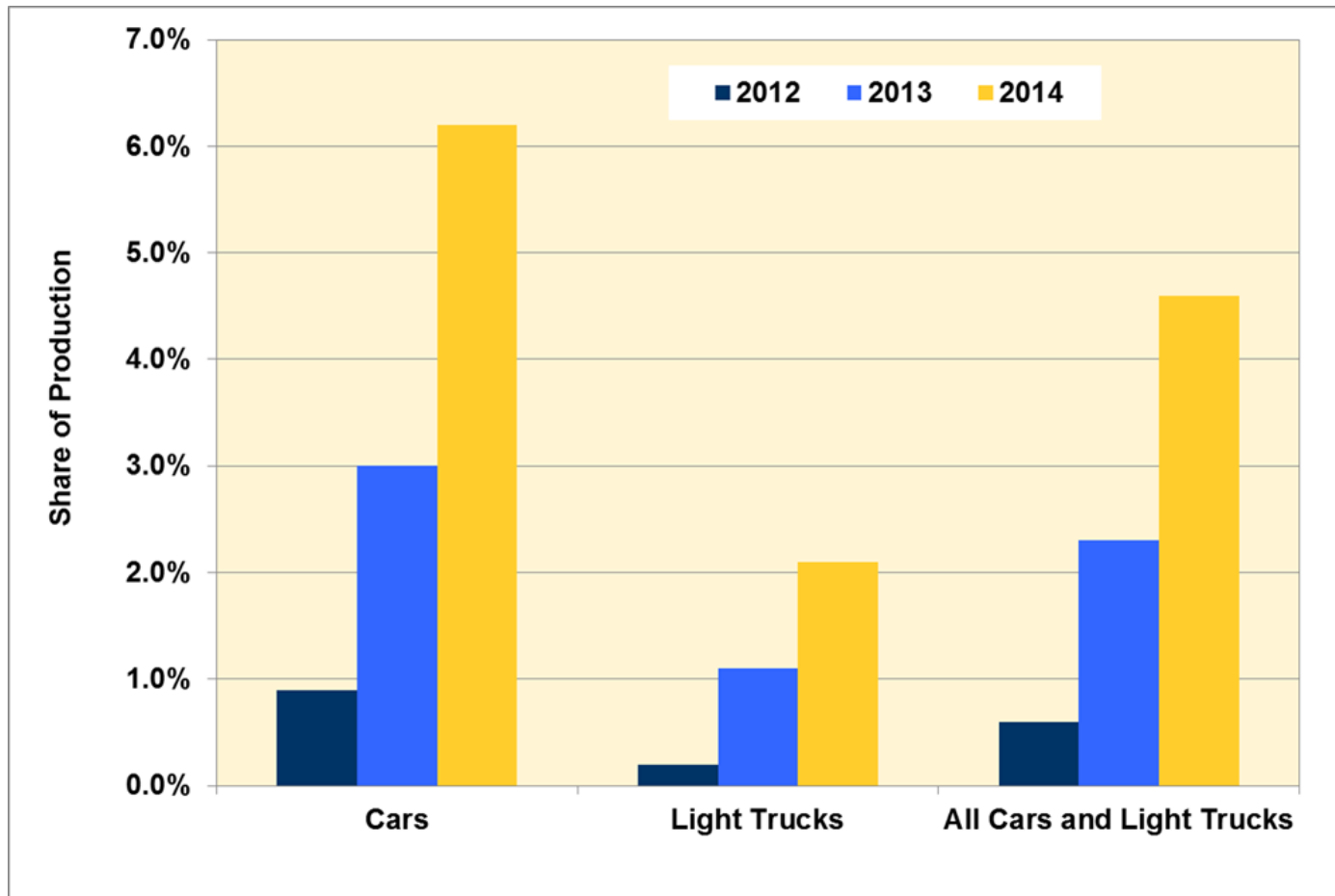
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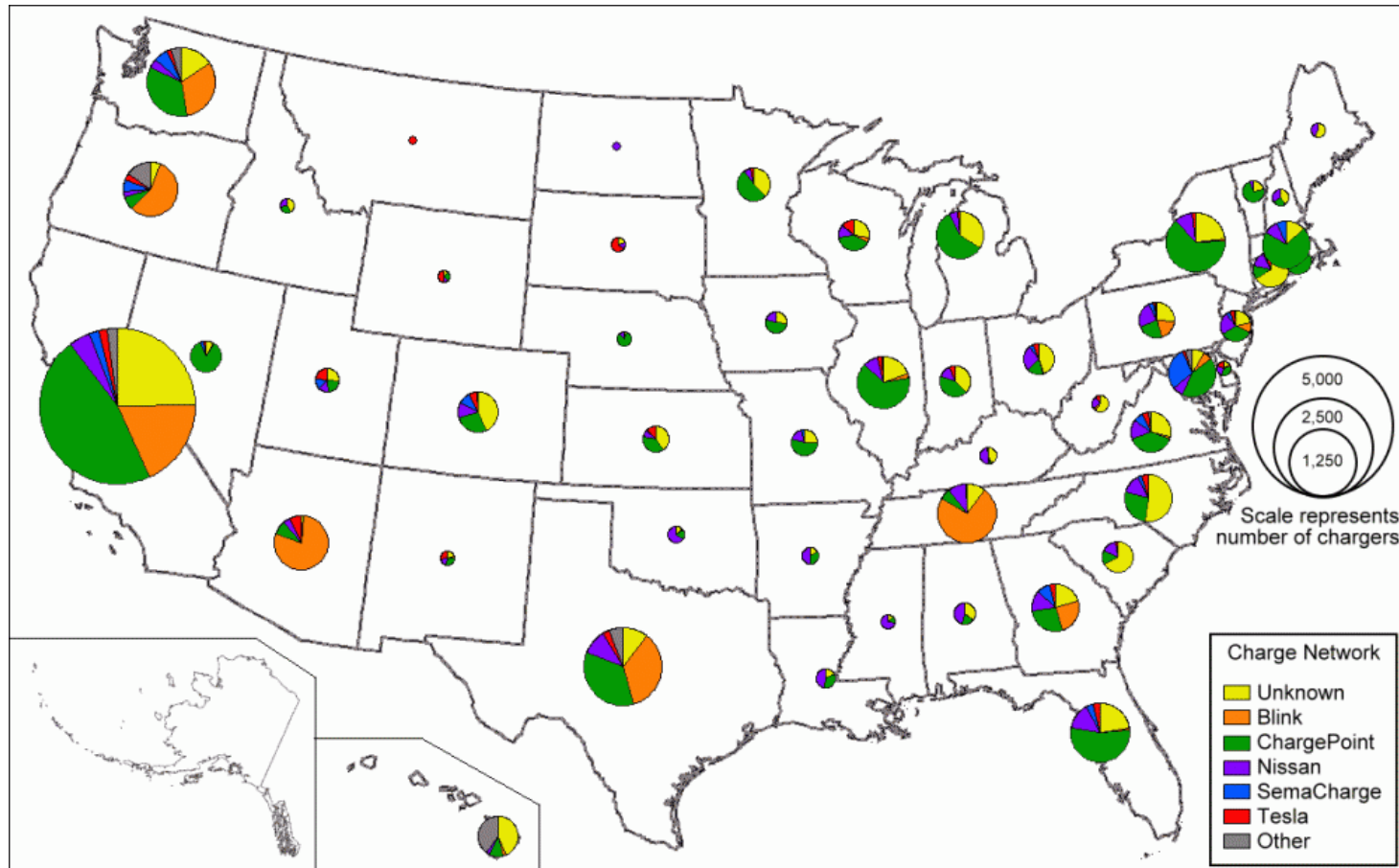
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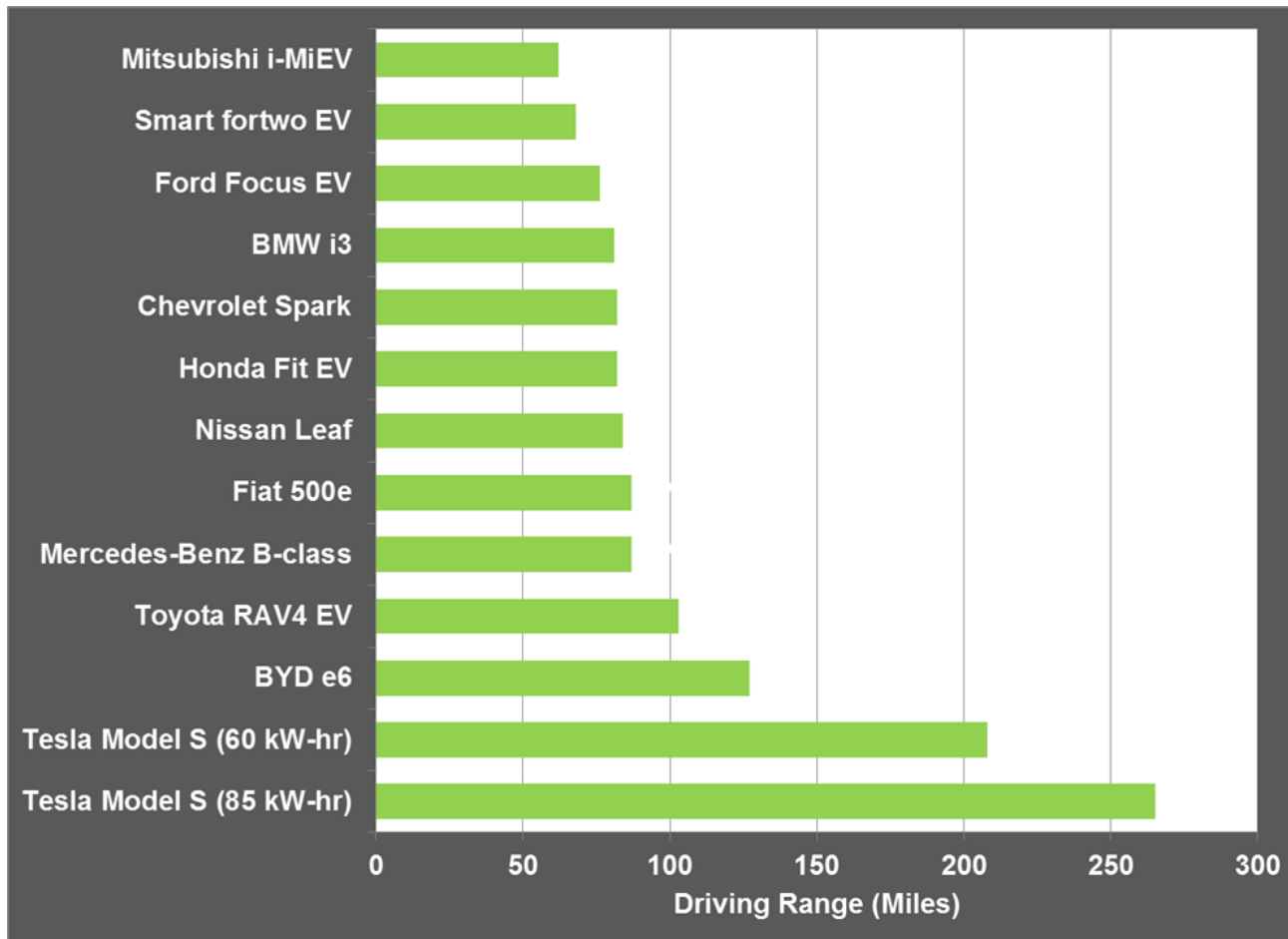
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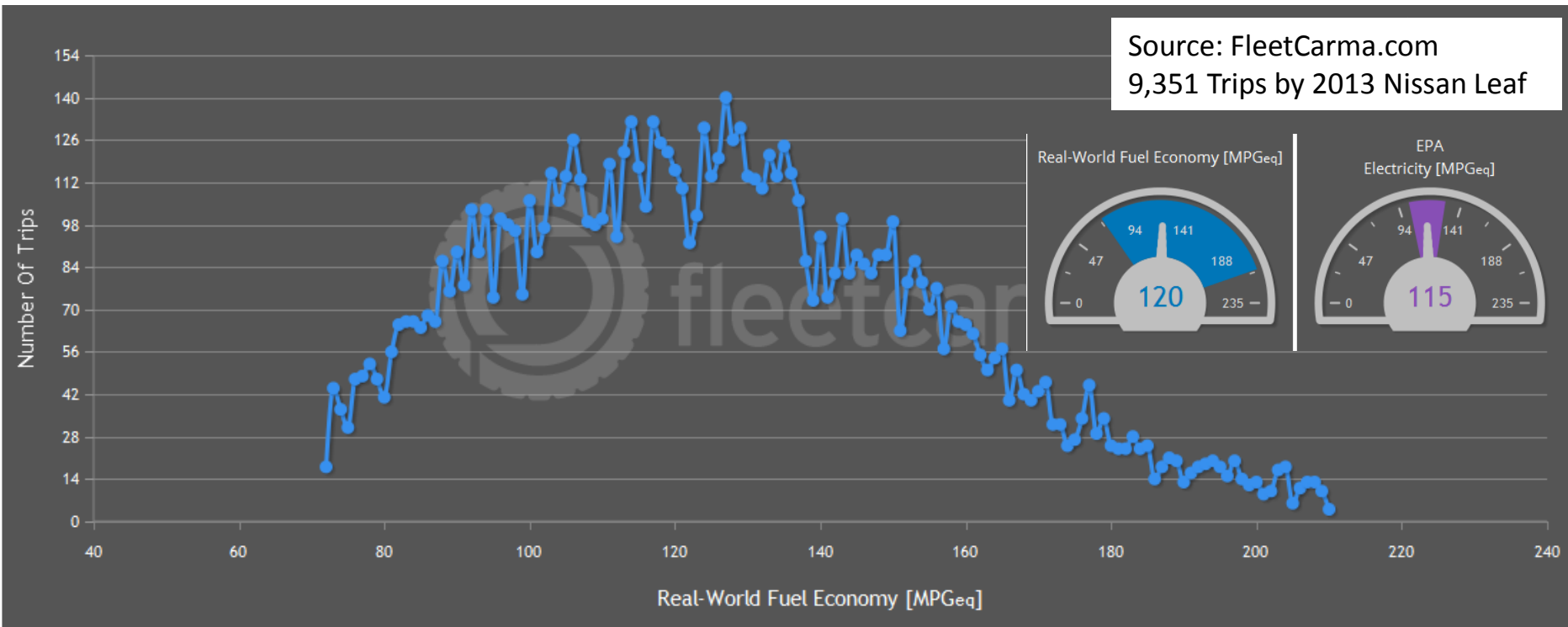
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topics

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4 environmental studies

consumers/opinion surveys

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4 environmental studies

grid emissions

- > EIA: Lower electricity-related CO₂ emissions reflect lower carbon intensity and electricity use.
- > FOTW: World renewable electricity consumption is growing (especially in China).

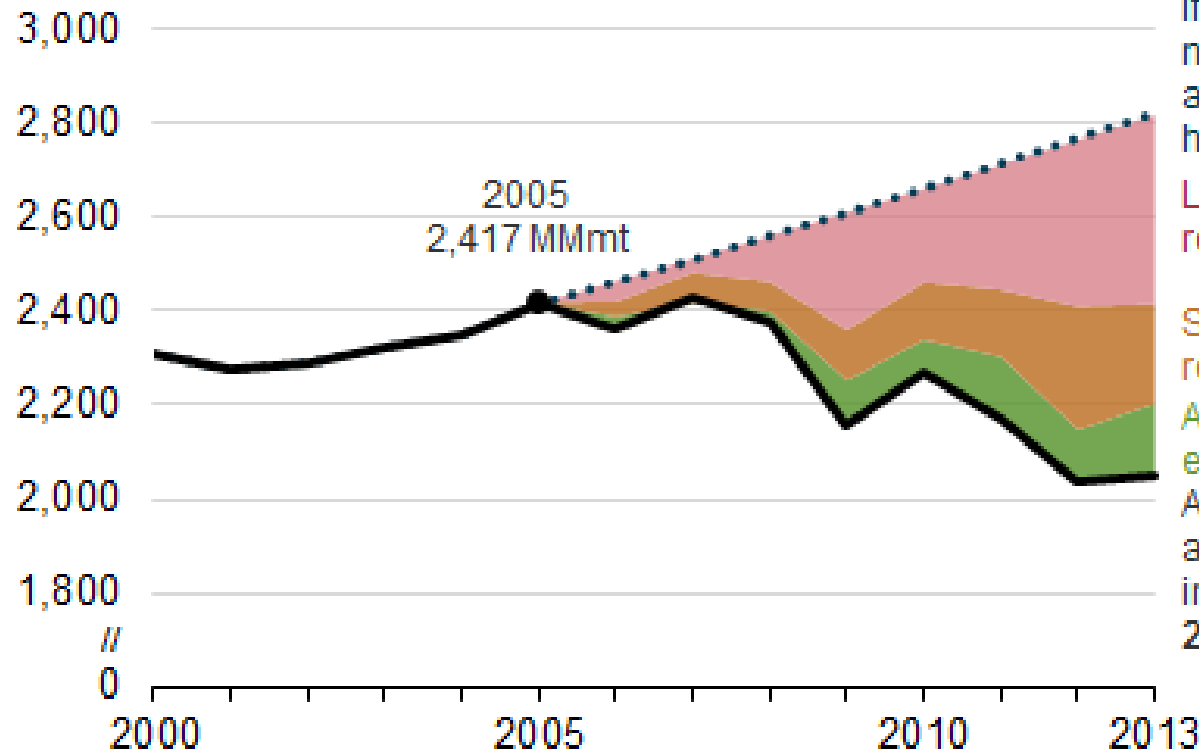
fuel economy trends

- > EPA: Average vehicle CO₂ emissions rate and fuel economy achieved record levels in MY2013.
- > EPA: More models meet fuel economy thresholds in MY2014.
- > EPA: <5% of MY2014 vehicles meet MY 2025 CO₂ targets (and all are advanced powertrain).

grid emissions

EIA: Lower electricity-related CO₂ emissions reflect lower carbon intensity and electricity use.

U.S. electric power carbon dioxide emissions (2000-2013)
million metric tons (MMmt) of carbon dioxide



If demand growth had remained near 2% and carbon intensity fixed at 2005 levels, emissions would have been **2,817 MMmt**

Lower demand growth alone reduced emissions by **402 MMmt**

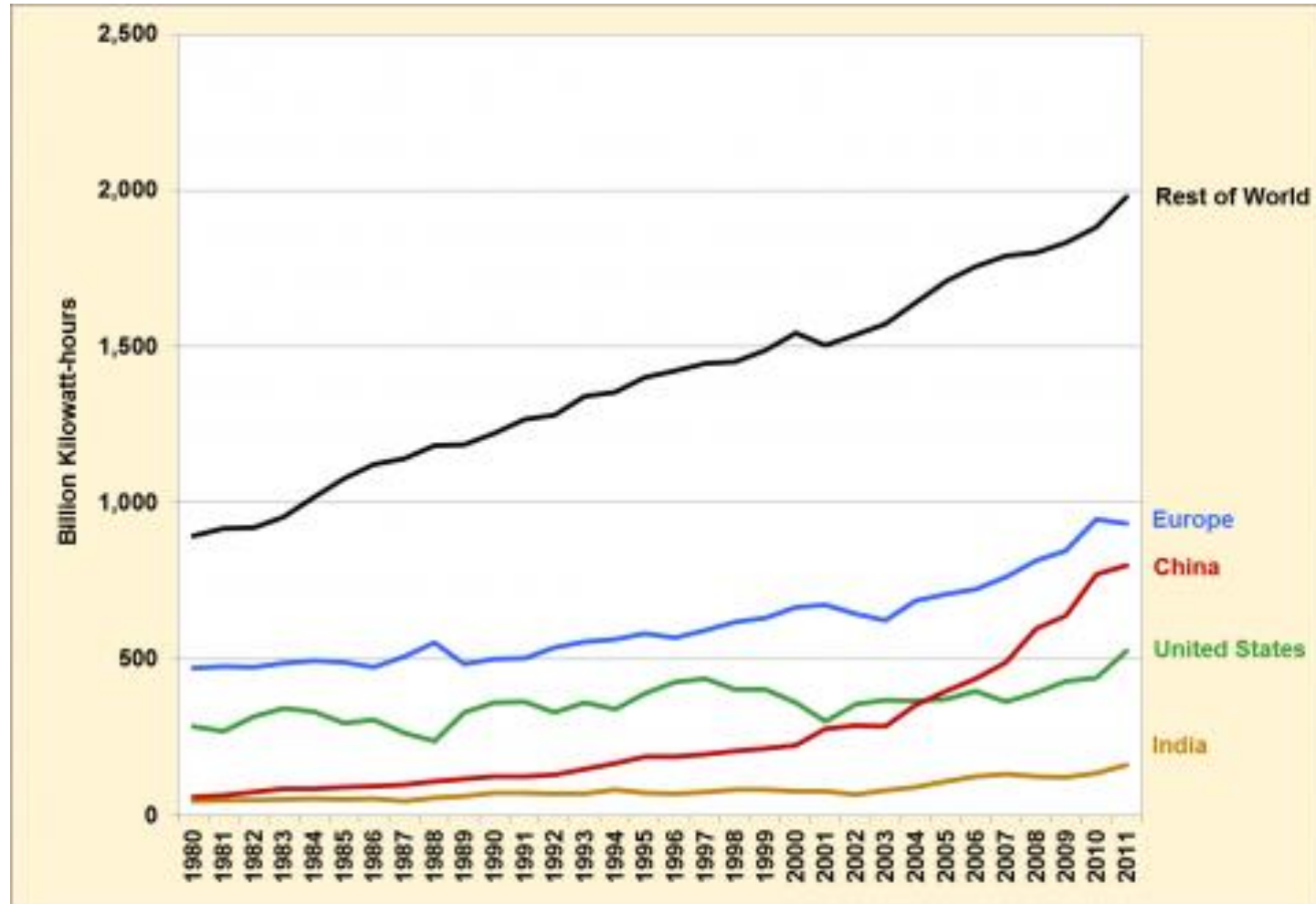
Switching among fossil fuels further reduced emissions by **212 MMmt**

Adding noncarbon sources reduced emissions by **150 MMmt**

After these reductions, actual carbon dioxide emissions in the power sector were **2,053 MMmt** in 2013.

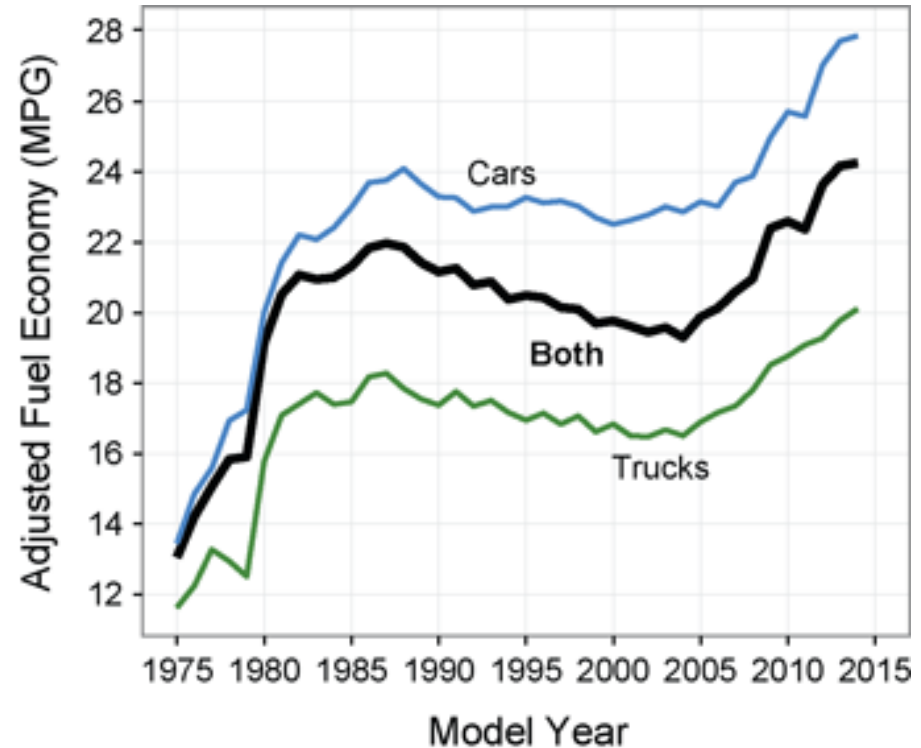
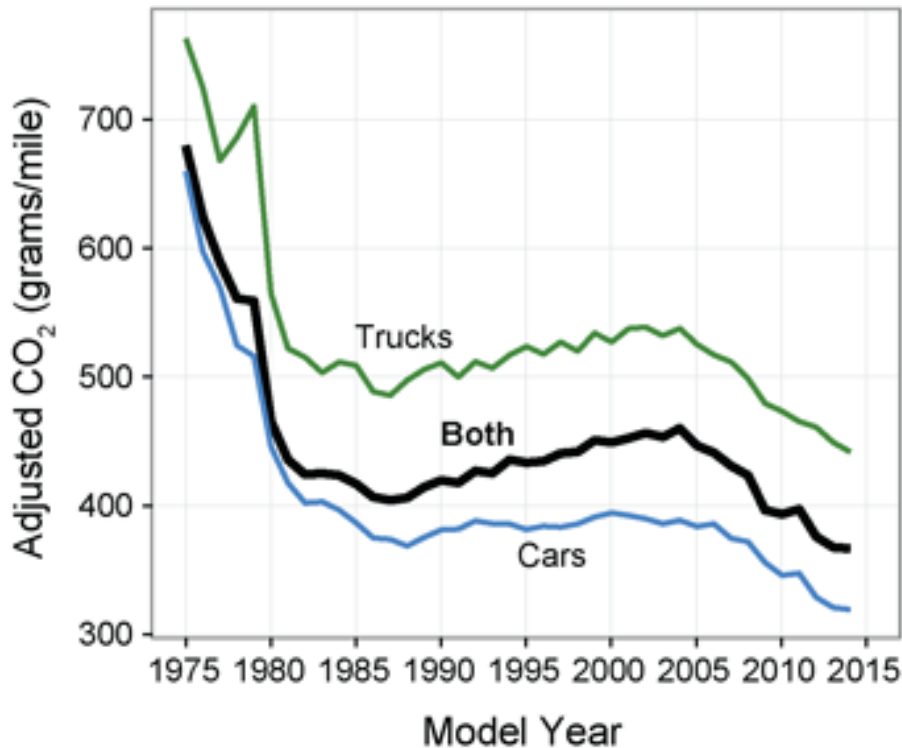
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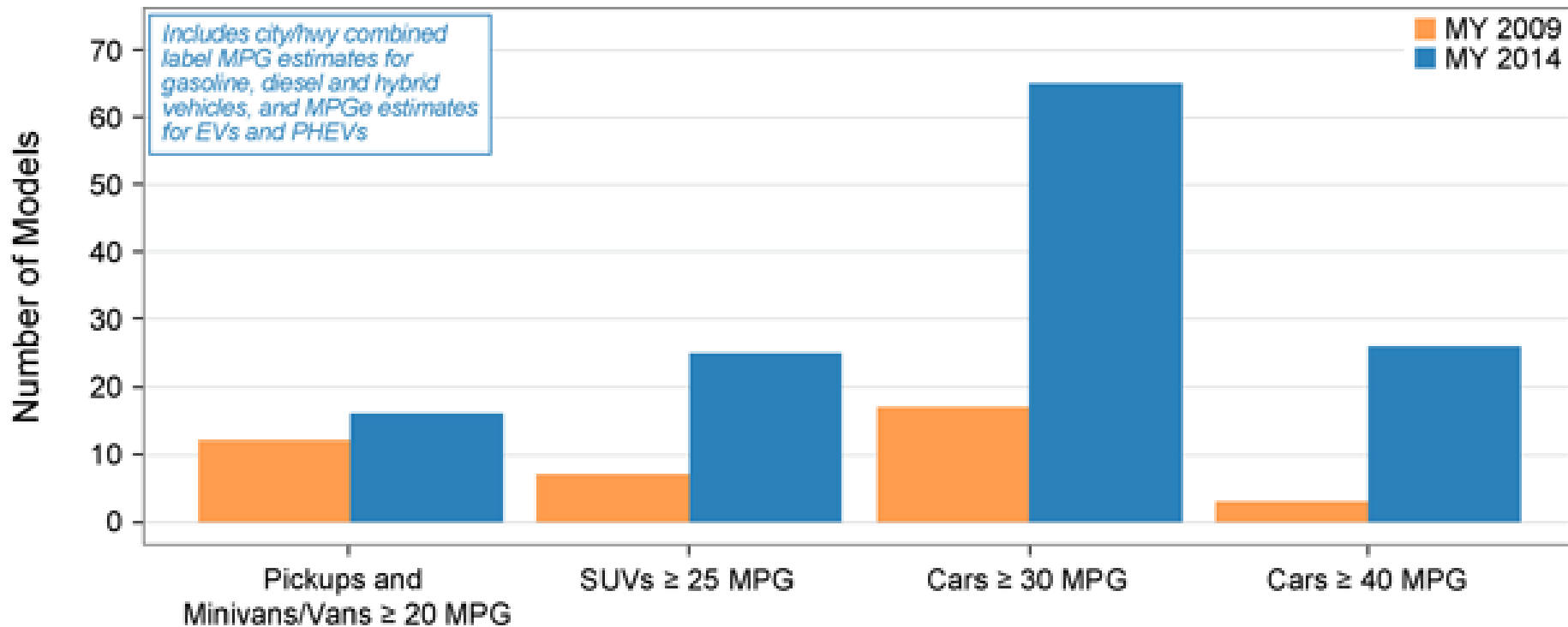
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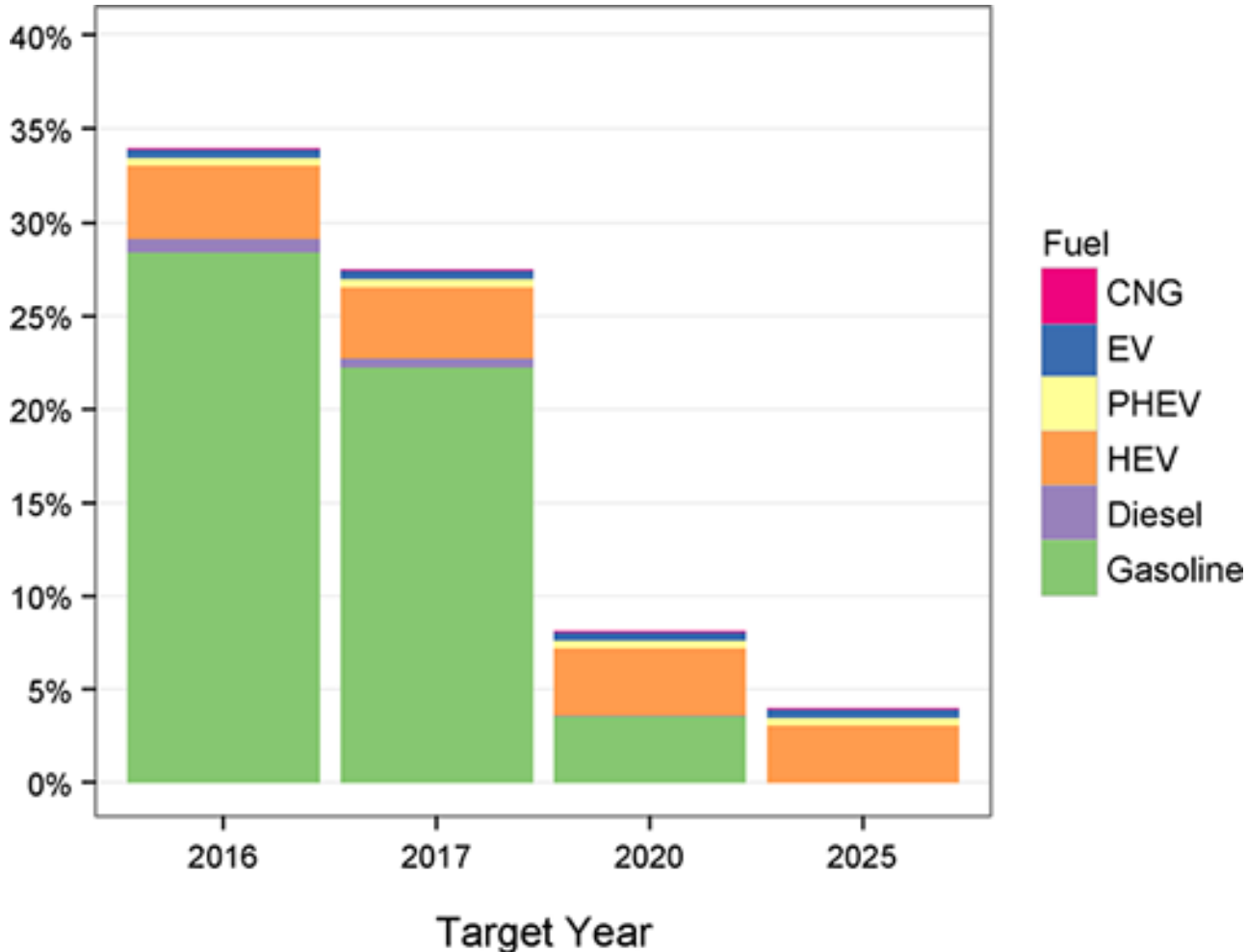
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topics

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5 consumers/opinion surveys

policy studies

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outline

5 consumer & opinion surveys

workplace charging

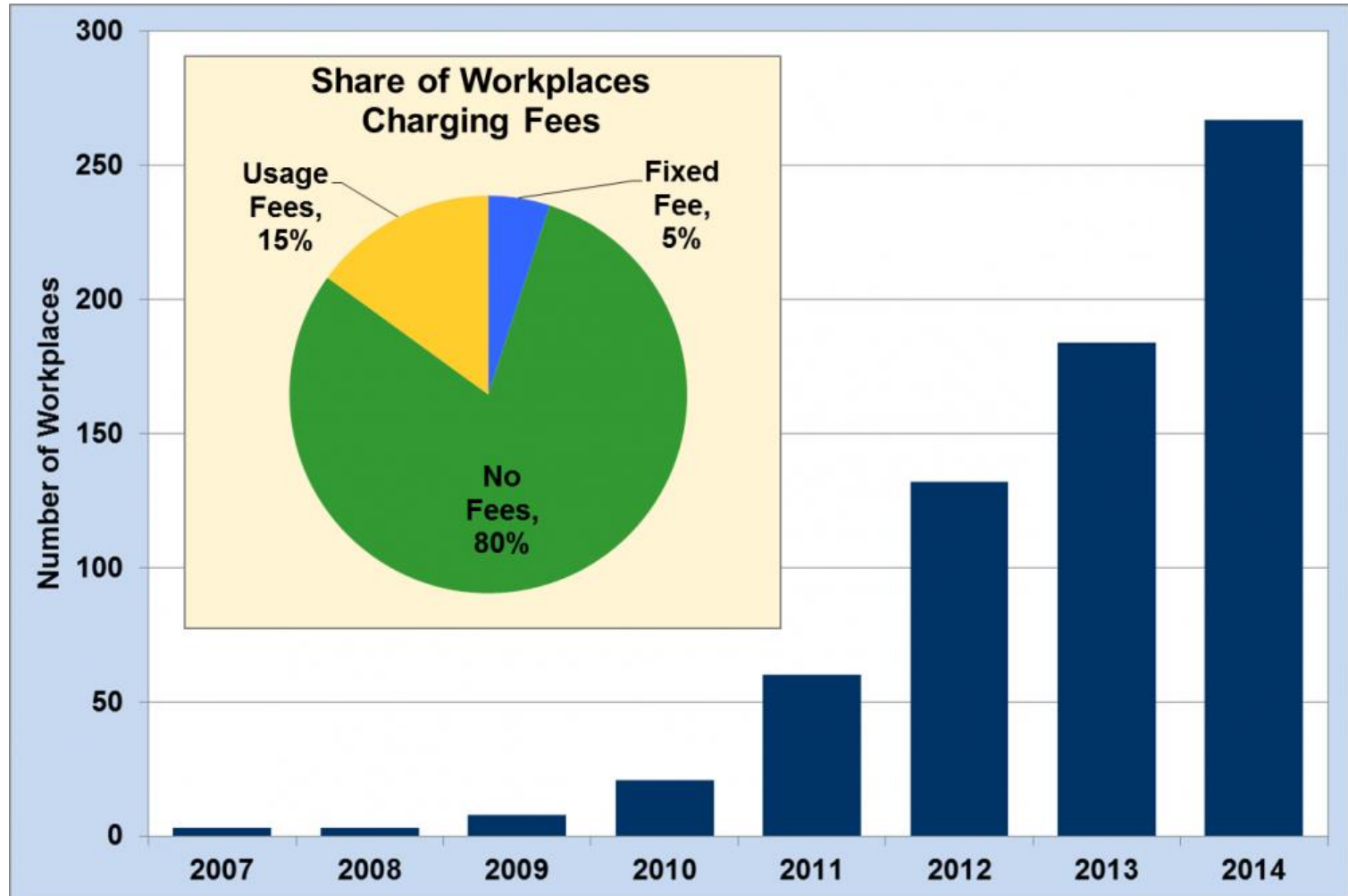
- > FOTW: Number of partner workplaces offering EV charging more than tripled since 2011.

consumer opinion

- > FOTW: Plug-in and hybrid cars receive high owner satisfaction scores (Consumer Reports).
- > FOTW: Relative importance of fuel economy decreases (but still 2nd-ranked)
- > UMTRI: Public opinion about self-driving vehicles differs by country.
- > UT Energy Poll: survey indicates renewable, efficiency, and EV technology subsidies favored.
- > CSE: Primary motivations for PEV purchase differ by advanced vehicle architecture.

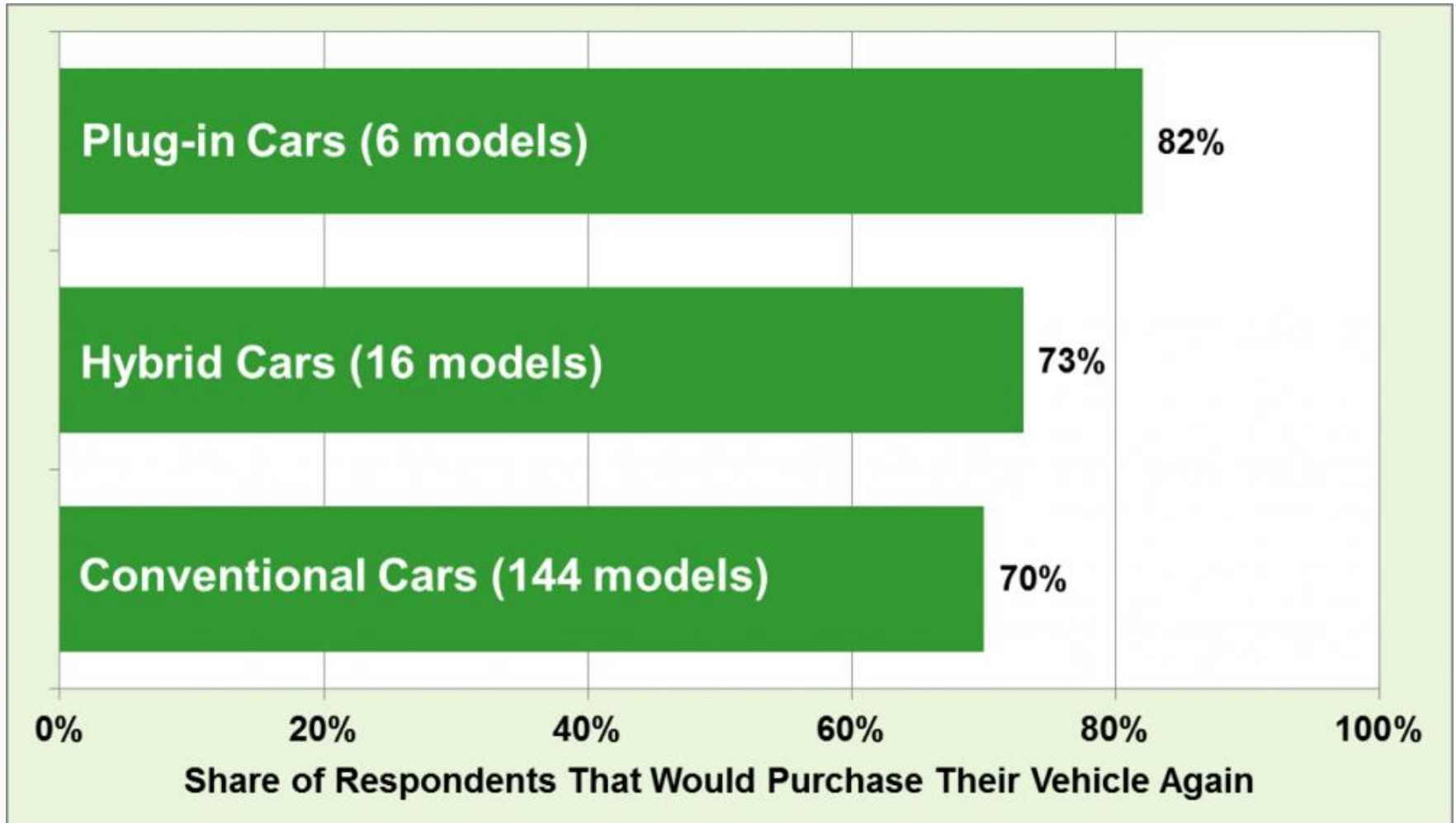
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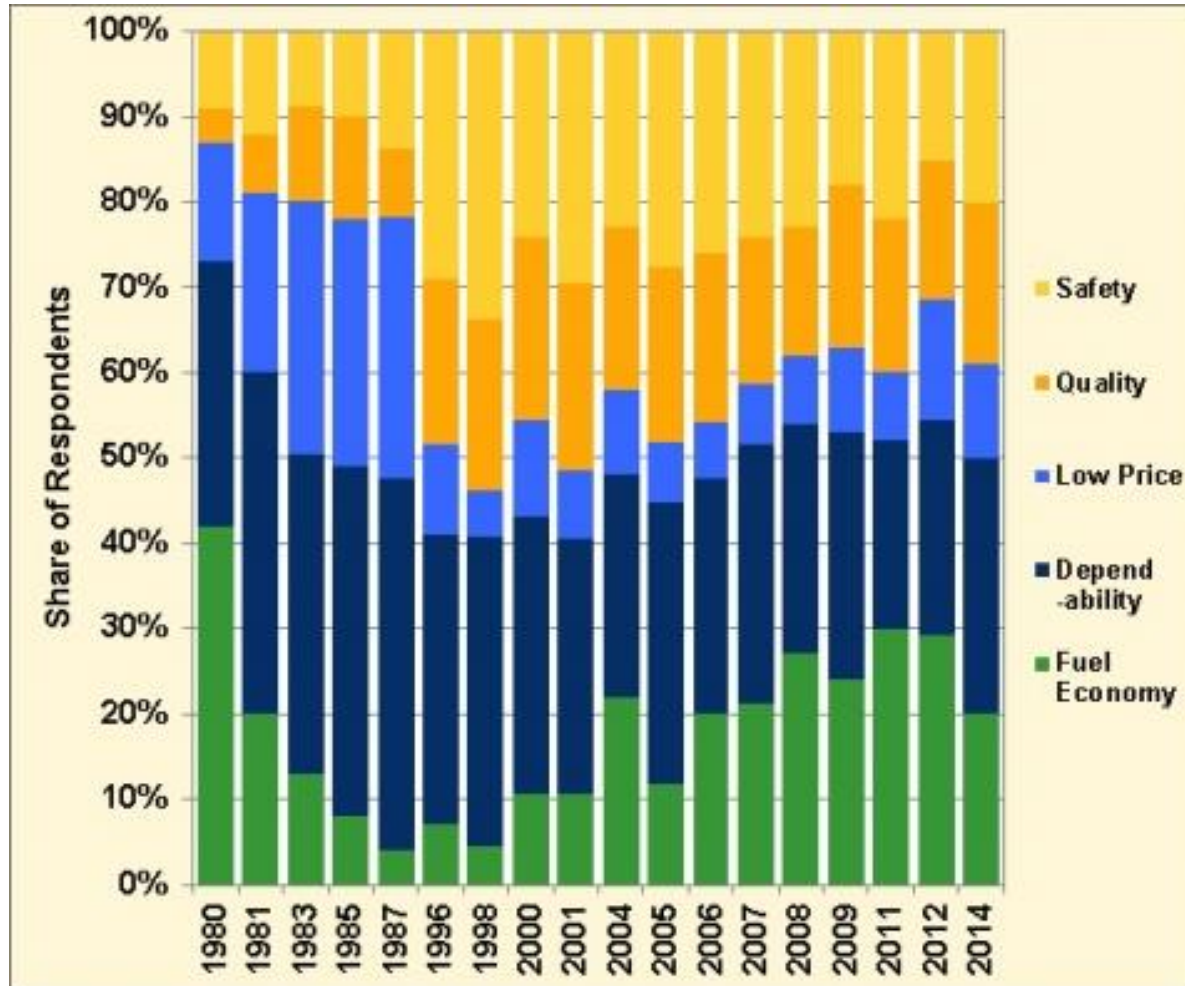
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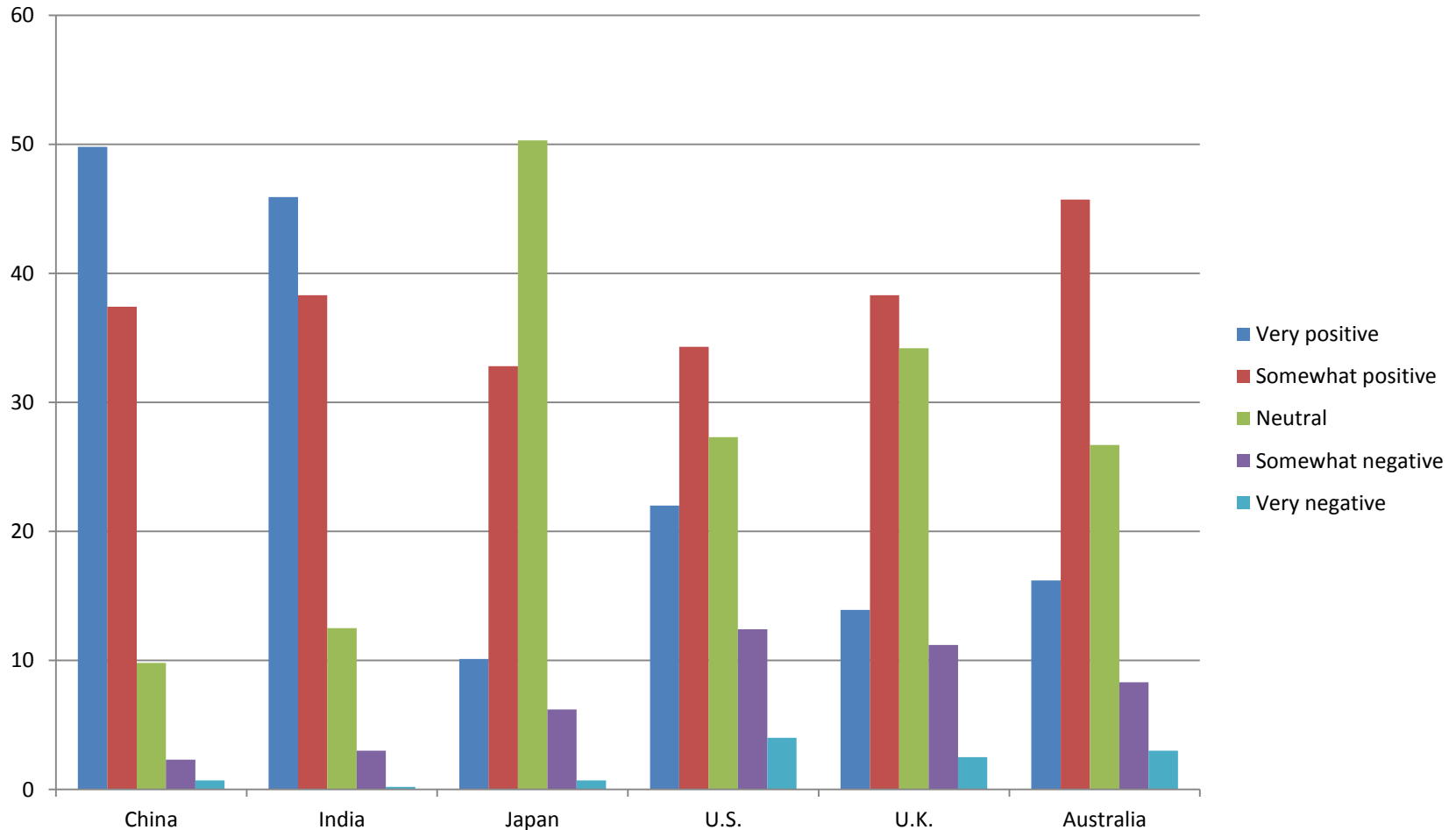
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consumer opinion

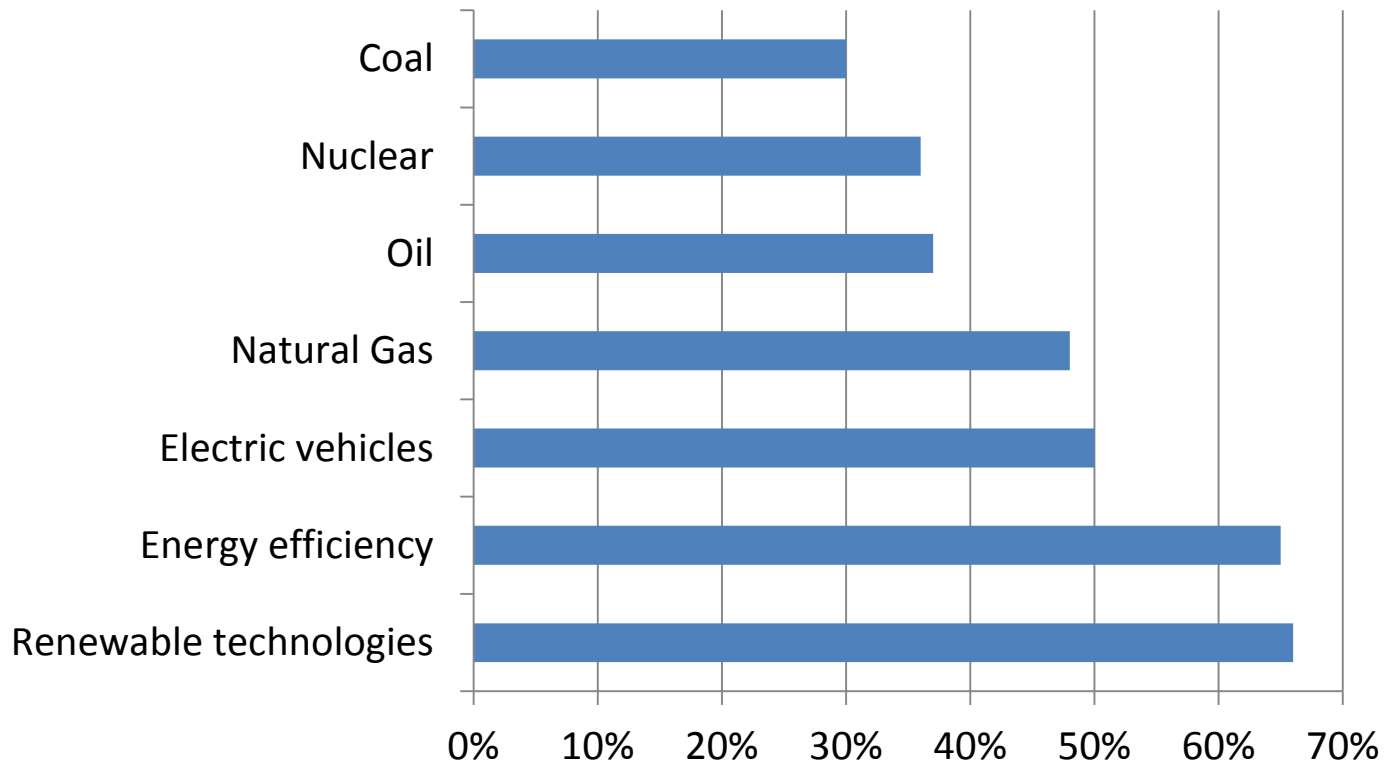
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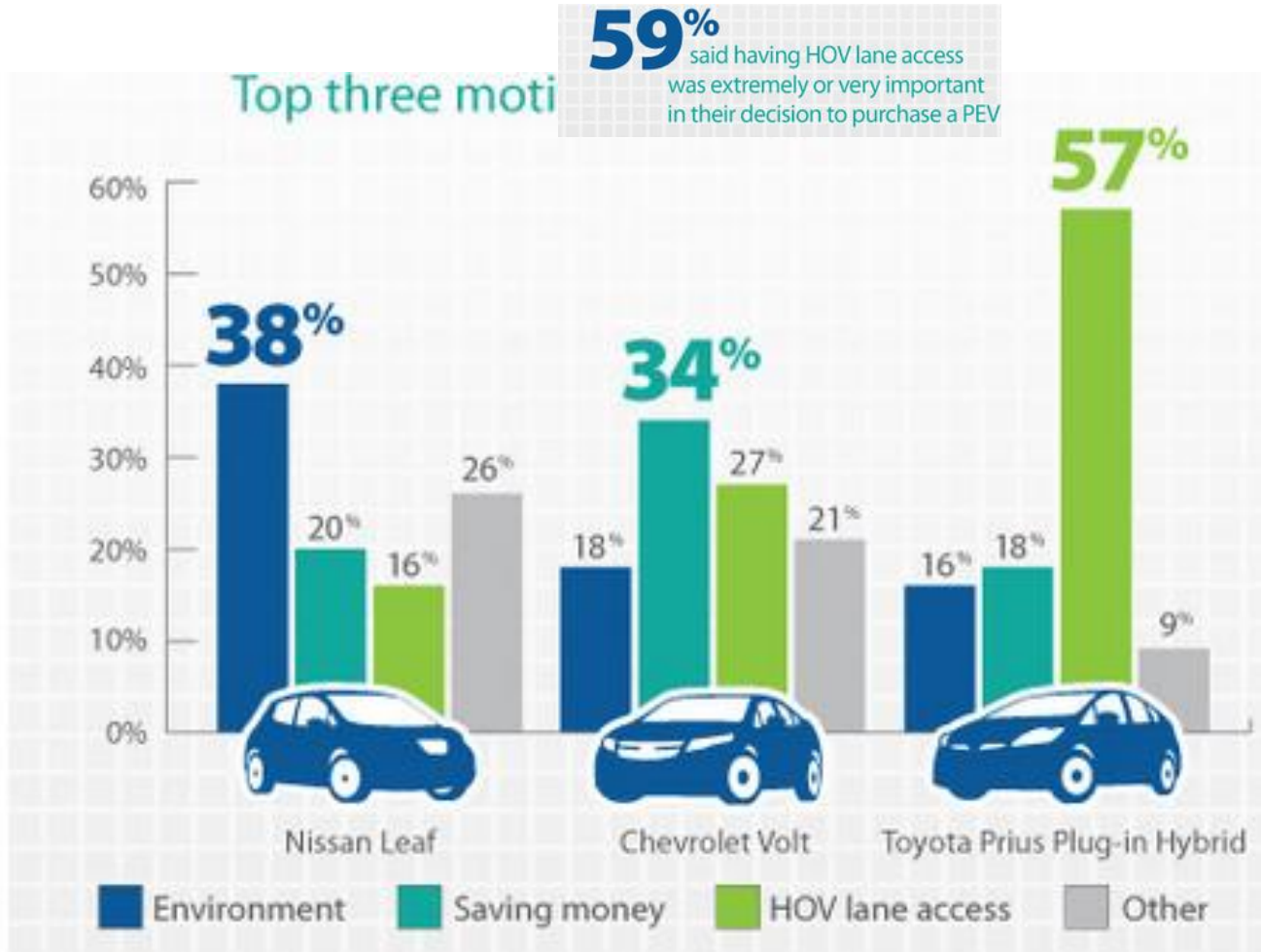
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“Should the federal government subsidize...?”



consumer opinion

CSE: Primary motivations for PEV purchase differ by advanced vehicle architecture.



topics

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consumers/opinion surveys

6 policy studies

qar
outline

6 policy studies

ev incentives

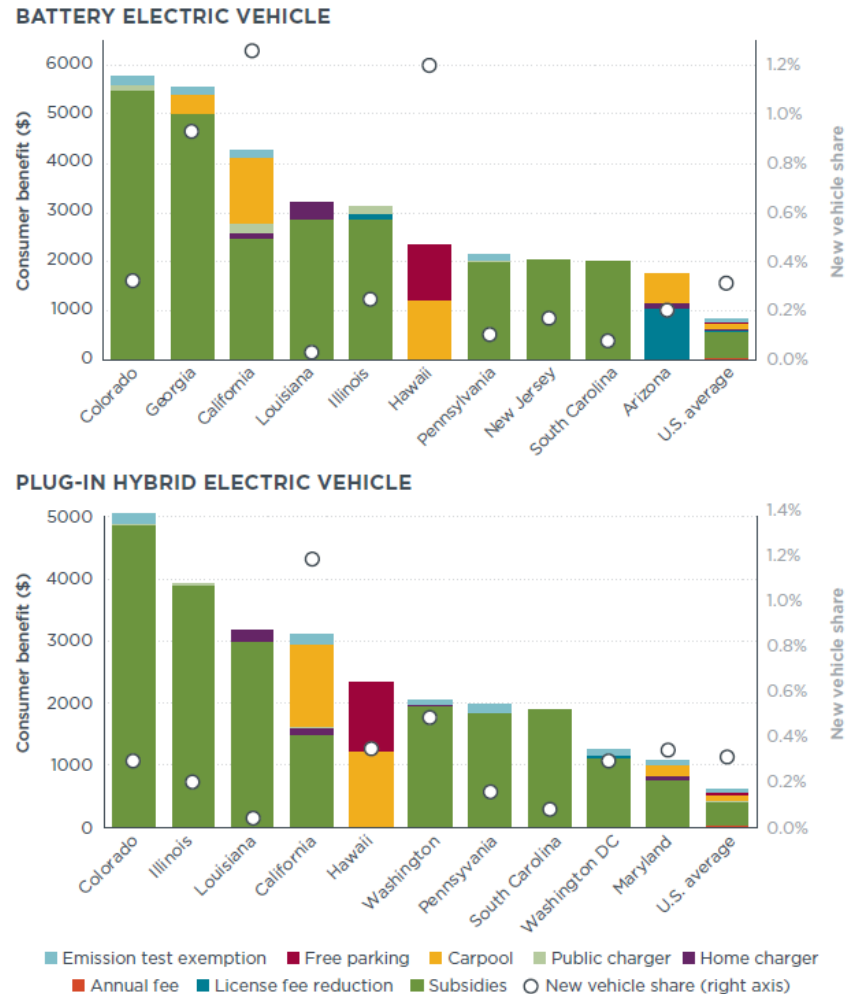
- > ICCT: Fully monetized state PEV incentives are not directly correlated to state PEV sales.
- > NREL: a \$1,000 increase in incentive corresponds to a 3% increase in per capita BEV registrations.

evse rollout

- > ANL: Charging infrastructure and PEV market shares differ greatly by state.

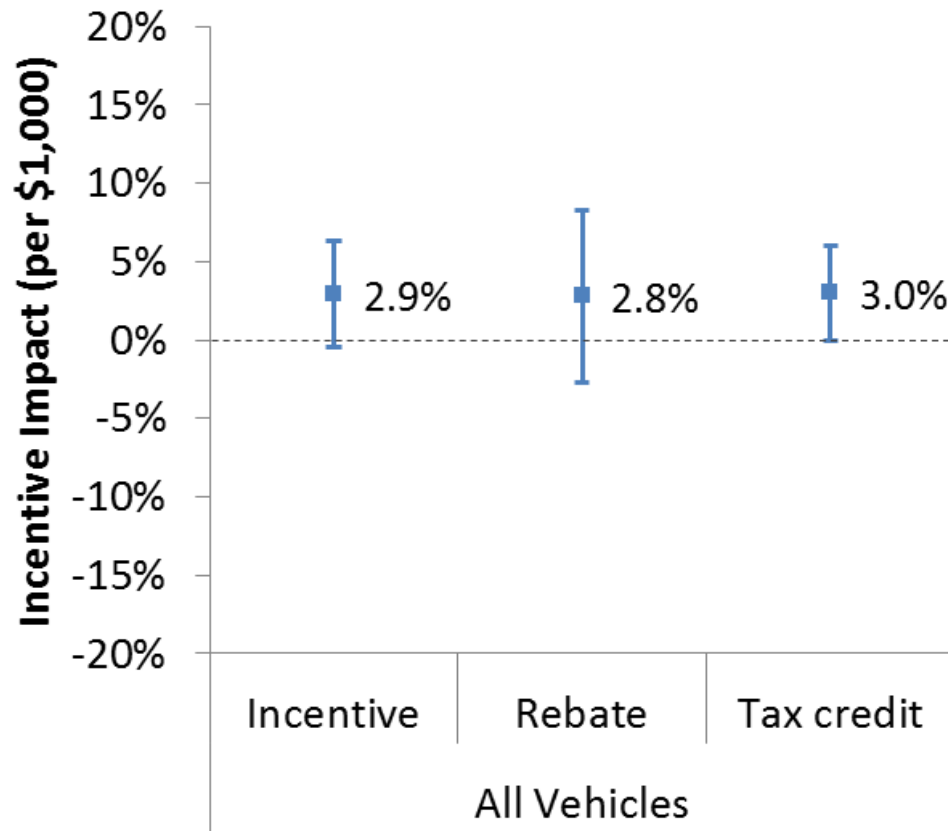
ev incentives

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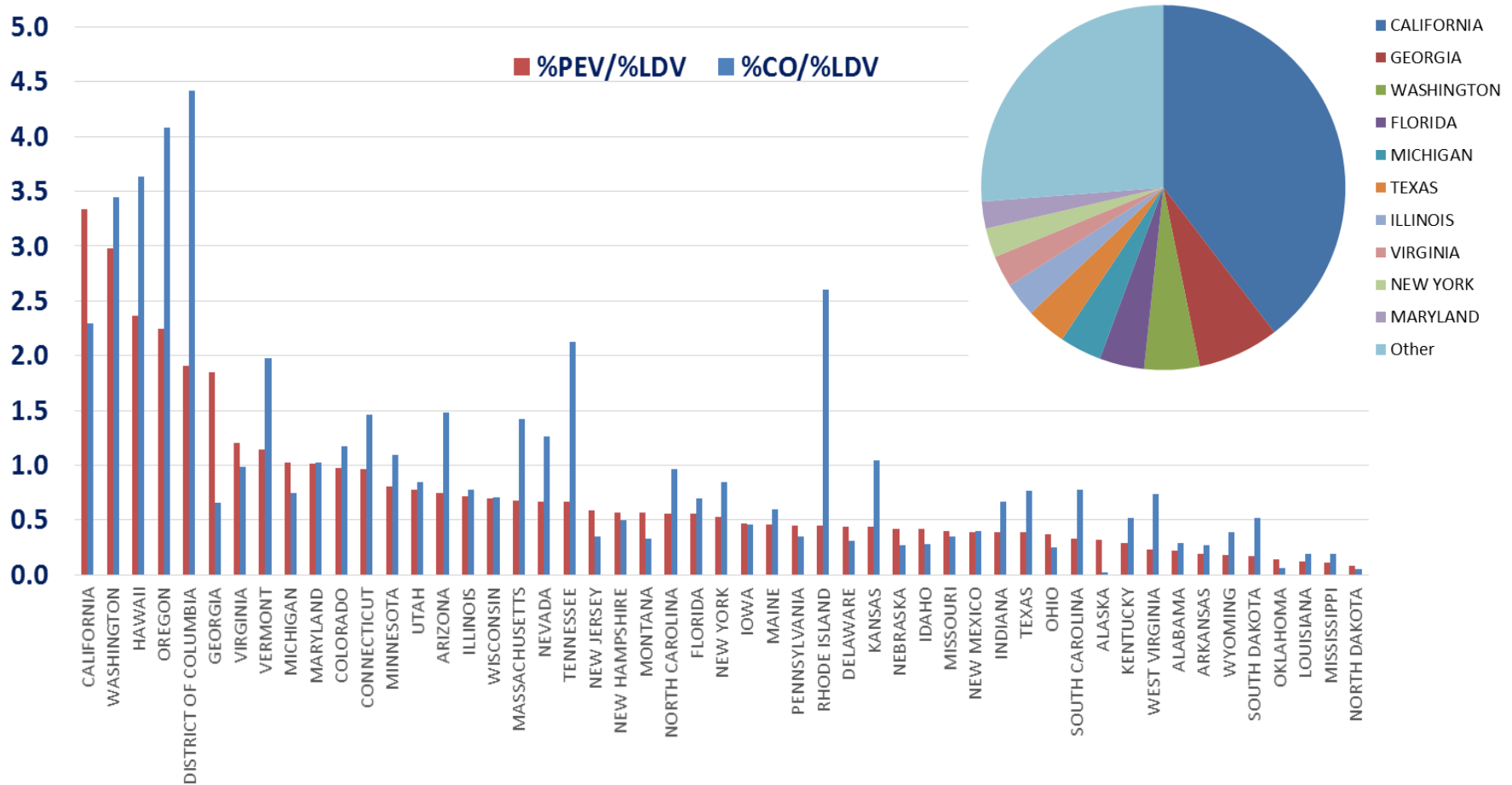
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Note: Error bars indicate 95% confidence interval.

evse rollout

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summary observations



energy

market projections estimate a decrease in relatively high-priced tight oil but an overall increase in U.S. domestic production.

automotive

the LDV market has more than fully rebounded after the 2008 economic crash.

tech/enviro

advanced vehicle/grid technologies continue to grow and offer benefits.

opinion/policy

heterogeneity in consumer opinions and motivations complicates policy and technology considerations.

14.3&4 **qar**
summary
3 & 4 Q 2014