quarterly analysis review

15.4

4Q 2015

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22 february 2016

topics

1 energy markets

automotive markets

technologies studies

environmental studies

consumer & opinion surveys

policy studies

qar

outline

1 energy markets

gasoline prices

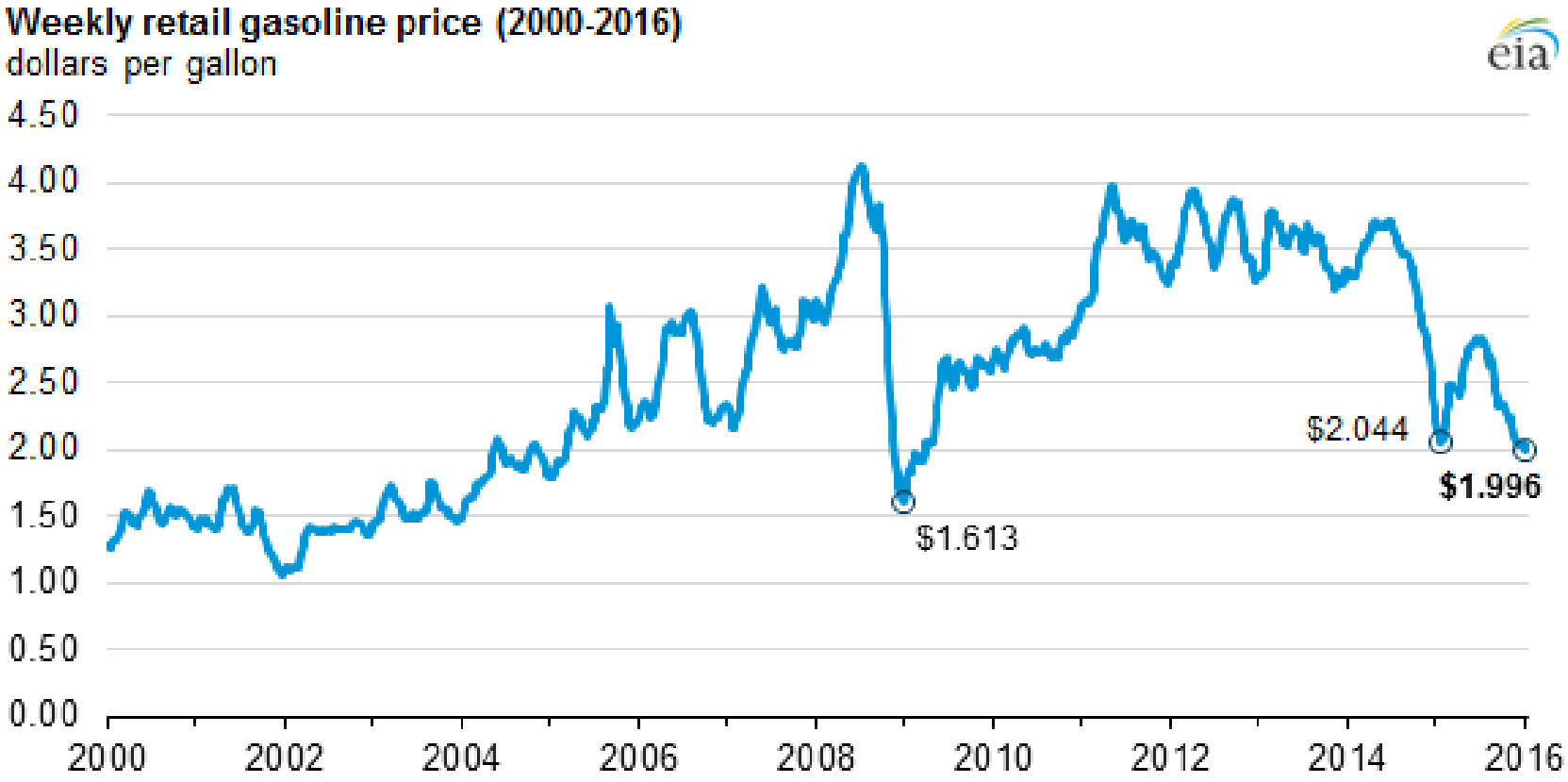
- EIA: National average gasoline and diesel prices fall below $2.00/gallon (consistently in 4 of 5 PADD regions)
- GasBuddy: Across states, gasoline prices range below $1.15 to over $2.30
- EIA: Gasoline projected to stay cheap for a while

oil markets

- EIA: High inventories driving low gas prices
- EIA: U.S. production projected to decline, while worldwide production continues to grow

gasoline prices

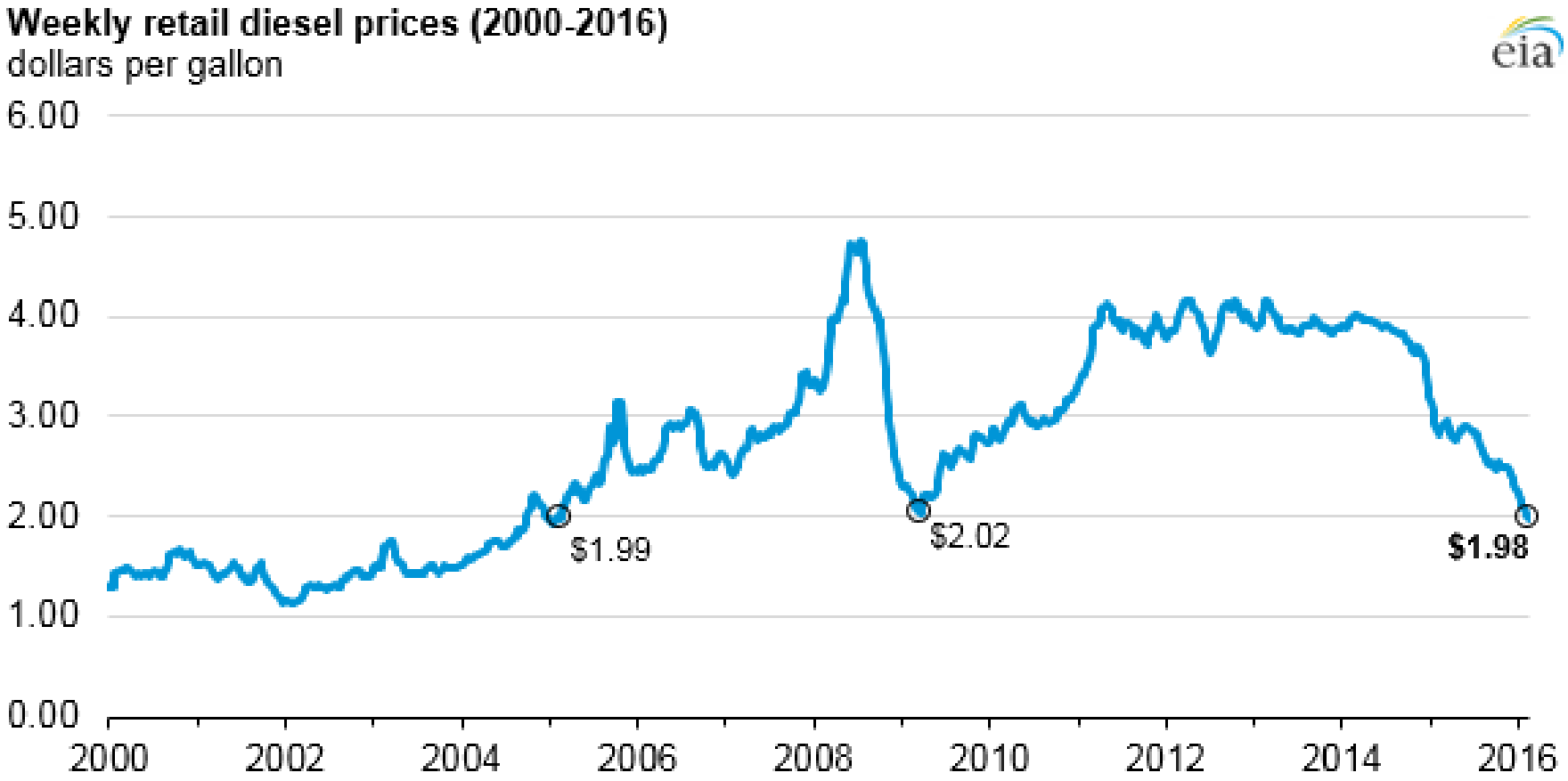
EIA: National average gasoline prices fall below $2.00/gallon for first time since 2009



Source: http://www.eia.gov/todayinenergy/detail.cfm?id=24552

diesel prices

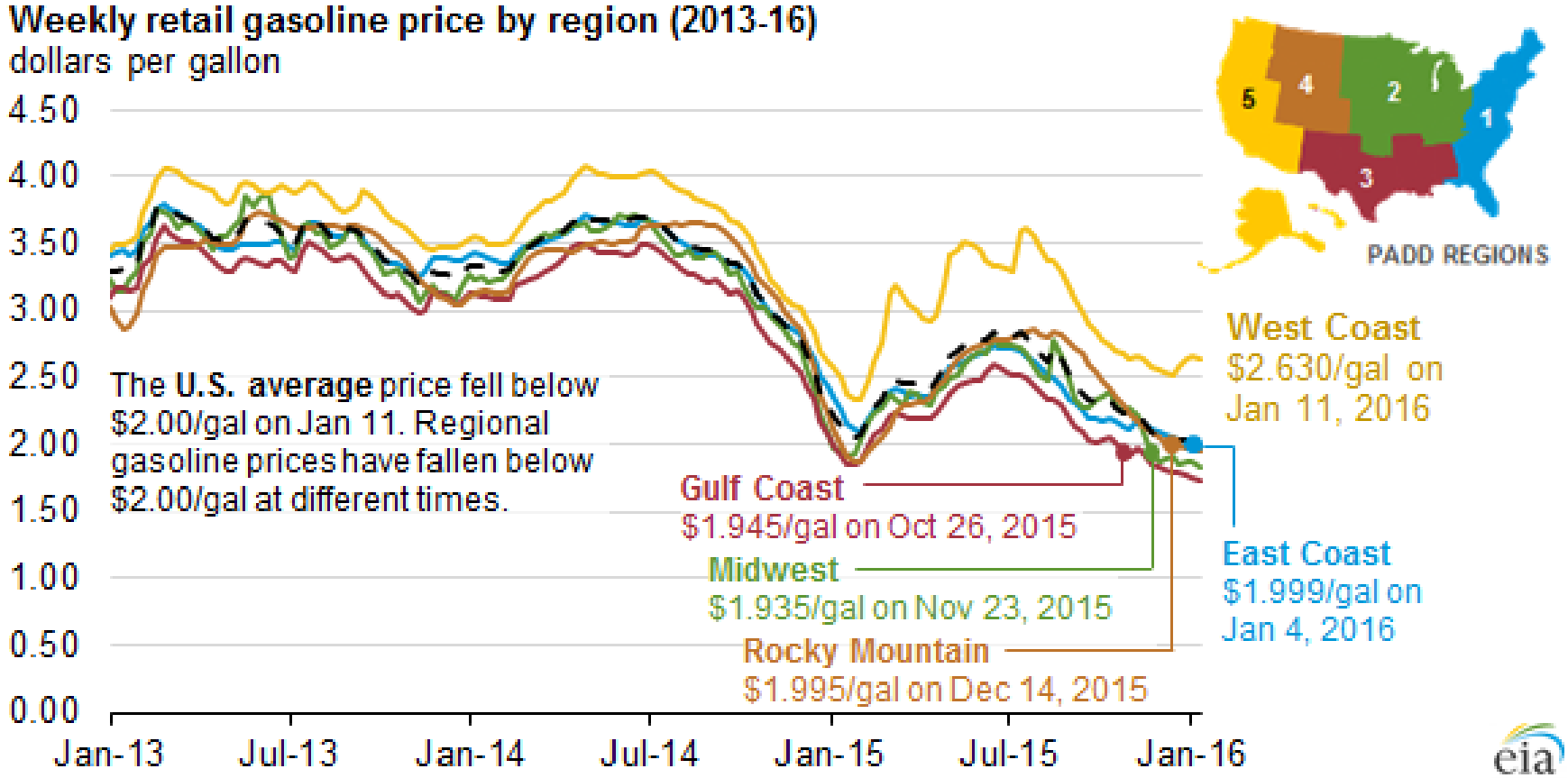
EIA: National diesel prices fall below $2.00/gallon for first time since 2005



Source: http://www.eia.gov/todayinenergy/detail.cfm?id=24992

gasoline prices

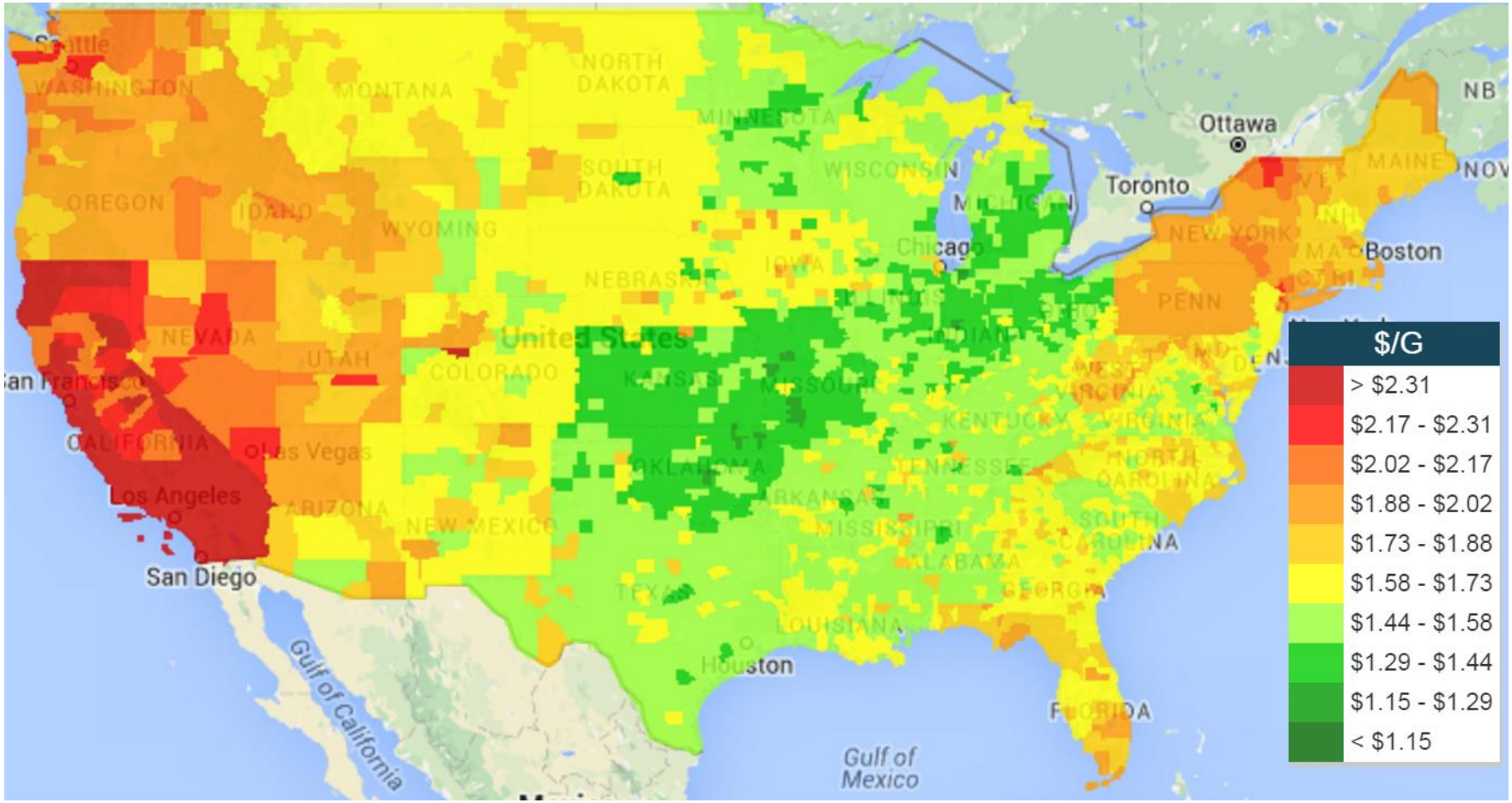
EIA: Gasoline prices below $2.00/gallon in four of five PADD regions



Source: http://www.eia.gov/todayinenergy/detail.cfm?id=24552

gasoline prices

GasBuddy: Across states, gasoline prices range below $1.15 to over $2.30 (Feb 11, 2016).



Source: http://www.gasbuddy.com/GasPriceMap?z=4

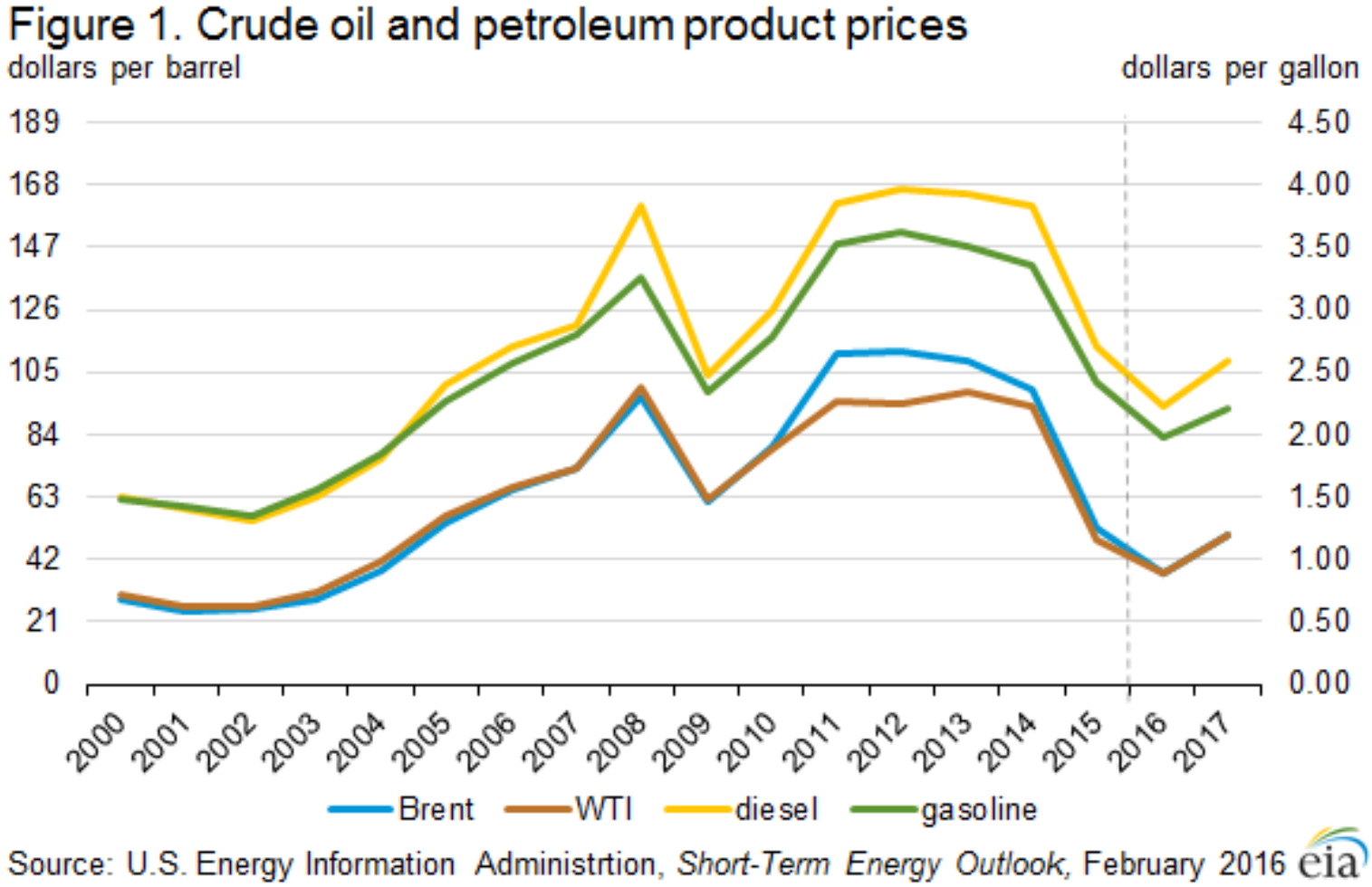
gasoline prices

ABC, NBC: Even more fine-grained differences can pop up from time to time

Source: http://nbc25news.com/news/local/gas-prices-continue-to-drop-in-houghton-lake
http://www.wxyz.com/news/michigan-becomes-first-state-to-welcome-back-gas-under-1

gasoline prices

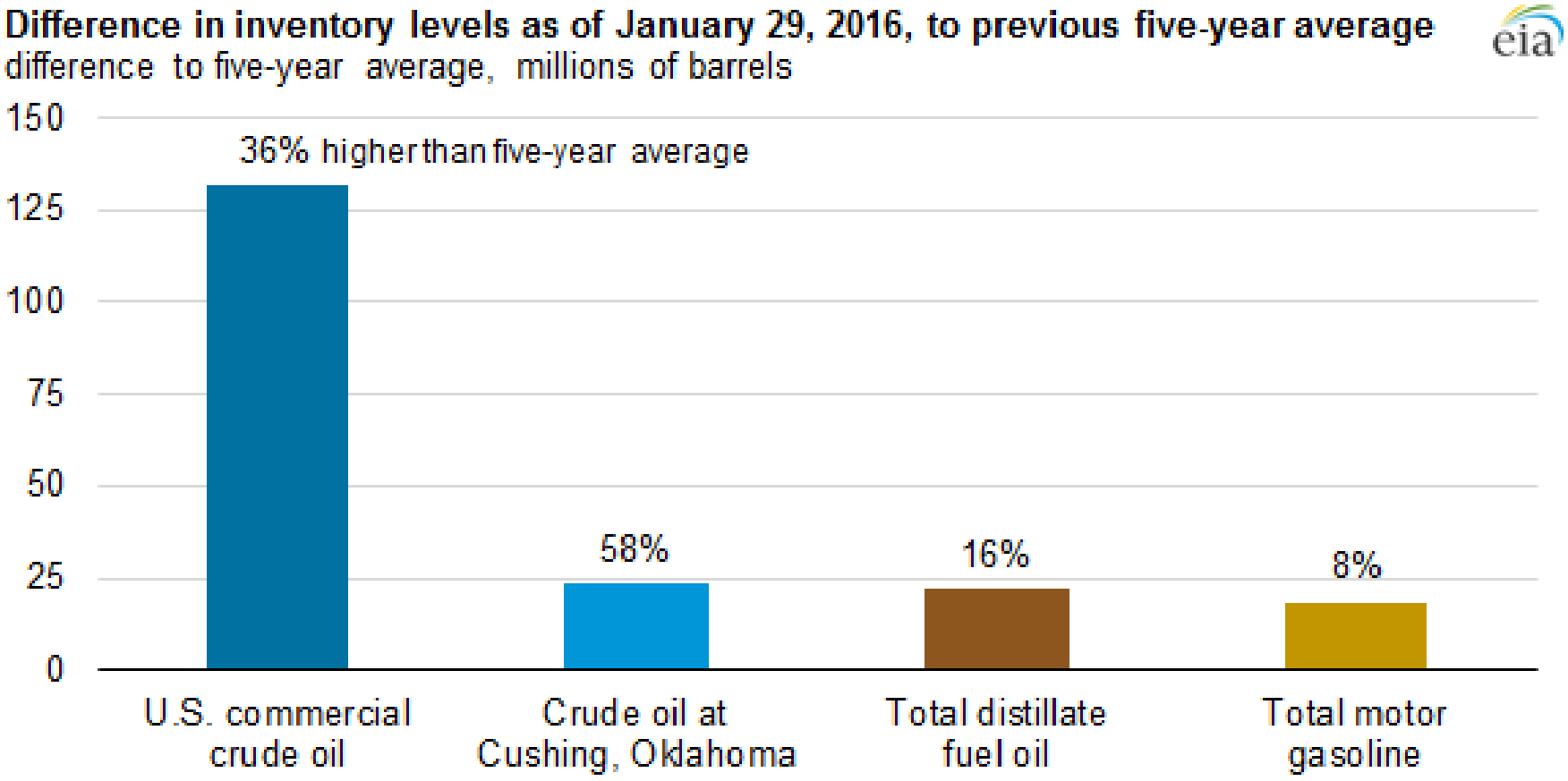
EIA: Gas prices are projected to stay low in short-term (2016-2017)



Source: http://www.eia.gov/petroleum/weekly/archive/2016/160210/includes/analysis_print.cfm

oil markets

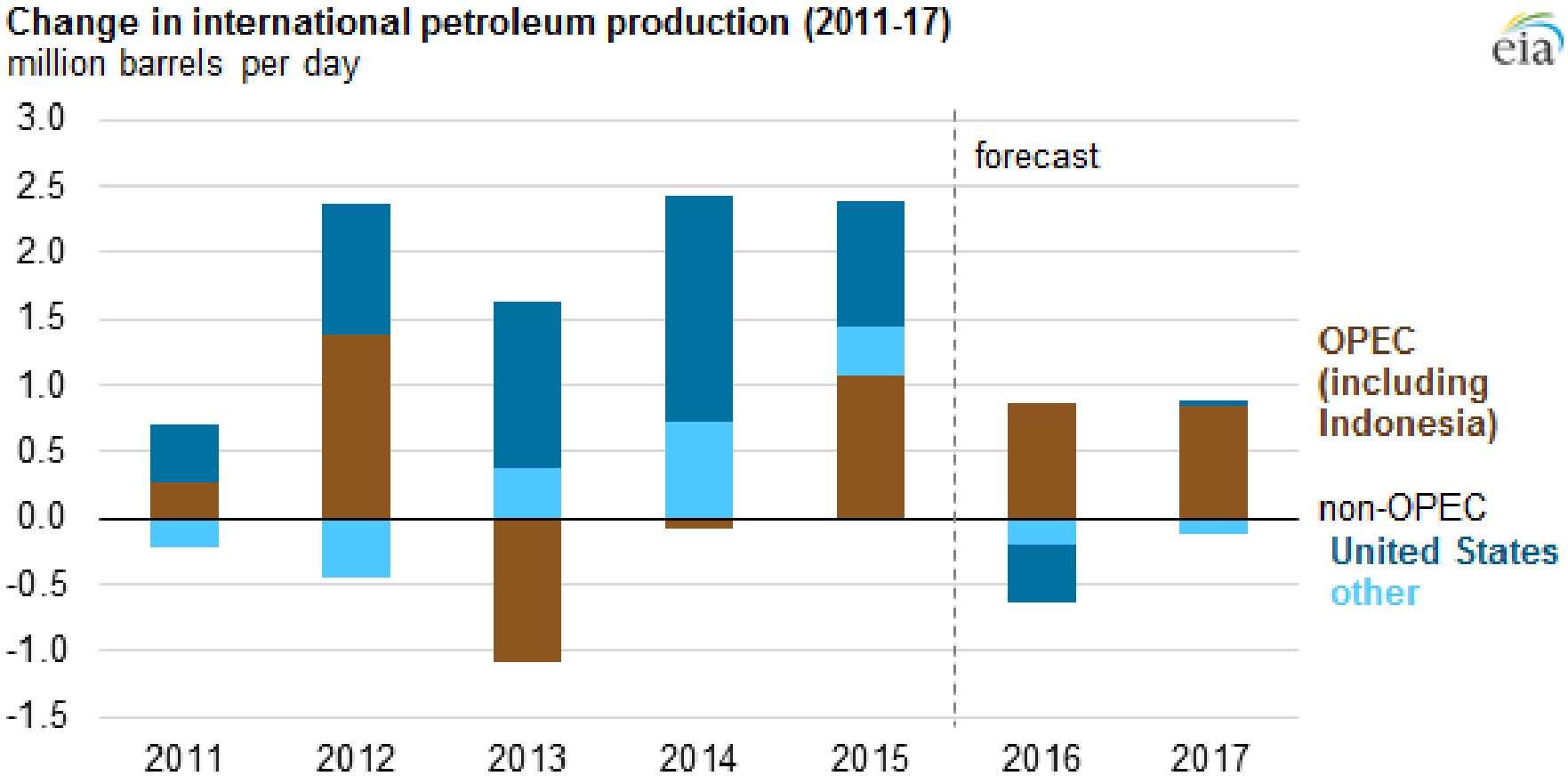
EIA: Oil inventory levels are well above their average over the previously 5-years



Source: http://www.eia.gov/todayinenergy/detail.cfm?id=24832

oil markets

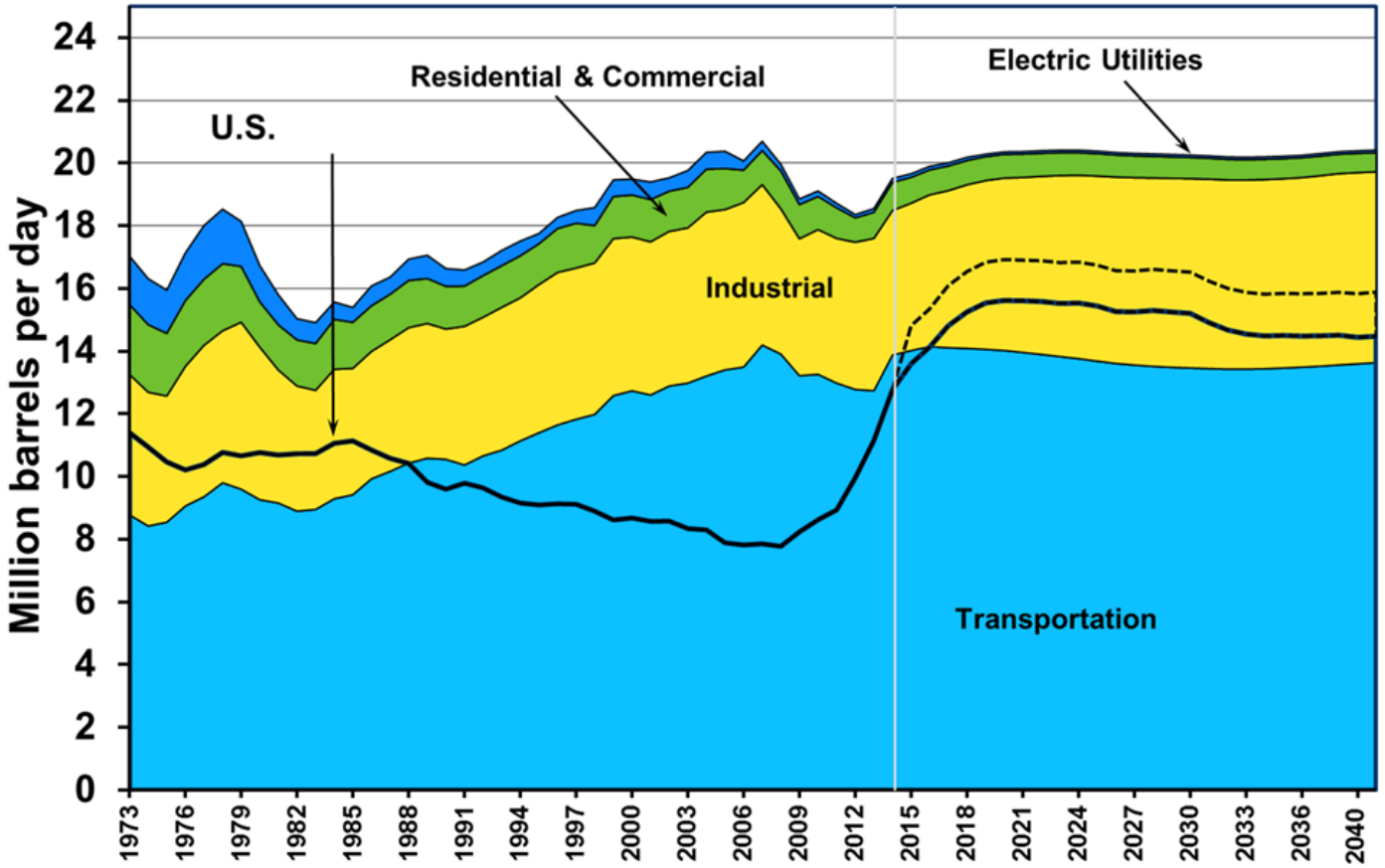
EIA: Near-term increase projected in petroleum production worldwide, but decrease in U.S.



Source: http://www.eia.gov/todayinenergy/detail.cfm?id=24832

oil markets

FOTW: U.S. petroleum production now almost equals U.S. transportation use



Source: http://energy.gov/eere/vehicles/fact-894-october-12-2015-us-petroleum-production-and-consumption-all-sectors-1973

topics

2 energy markets

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qar

outline

2 automotive markets

LDV market

> FOTW: All-time high in light-duty vehicle sales
> ANL: Light trucks outselling cars for last several years

hybrid market

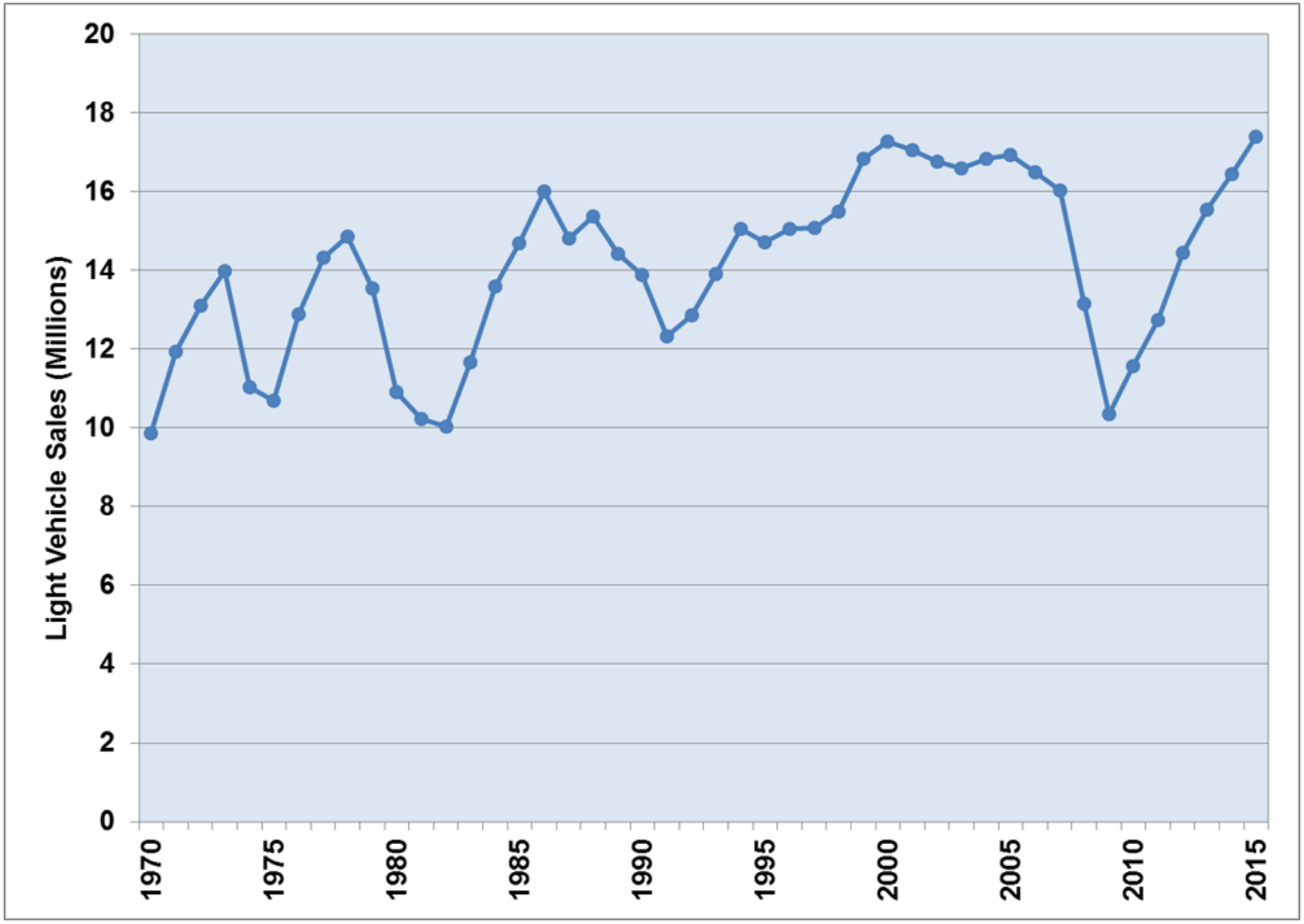
> ANL: Lowest selling hybrid numbers since 2011

PEV market

> ANL: U.S. PEV sales stagnate
> ACEA/EV Sales: Worldwide EV sales up in 2015
> Bloomberg: BEV ownership costs comparable to ICE vehicles

LDV market

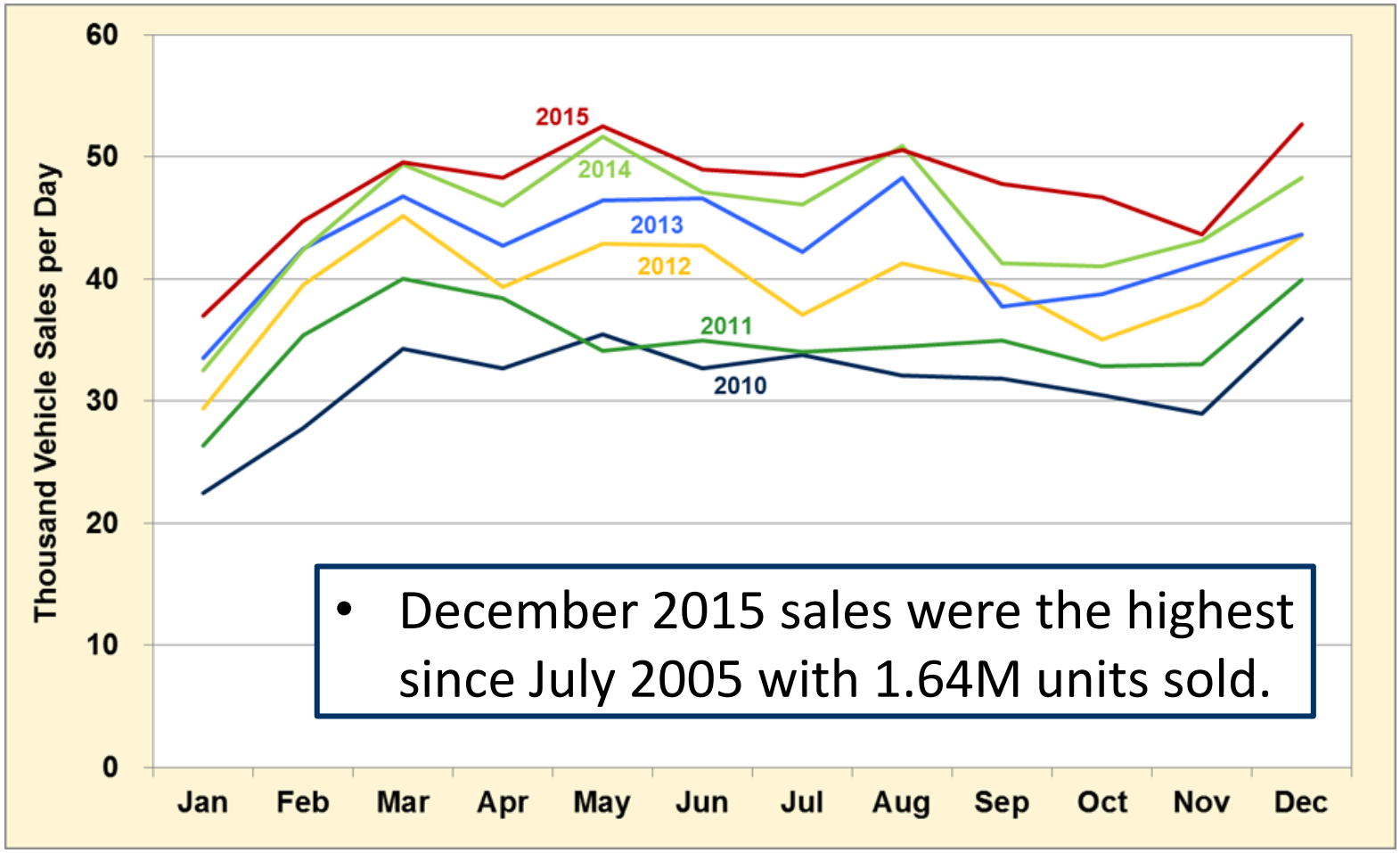
FOTW: Light-duty vehicle sales are at all-time high at over 17 million sold in 2015



Source: http://energy.gov/eere/vehicles/fact-907-january-11-2016-light-vehicle-sales-record-high-2015

LDV market

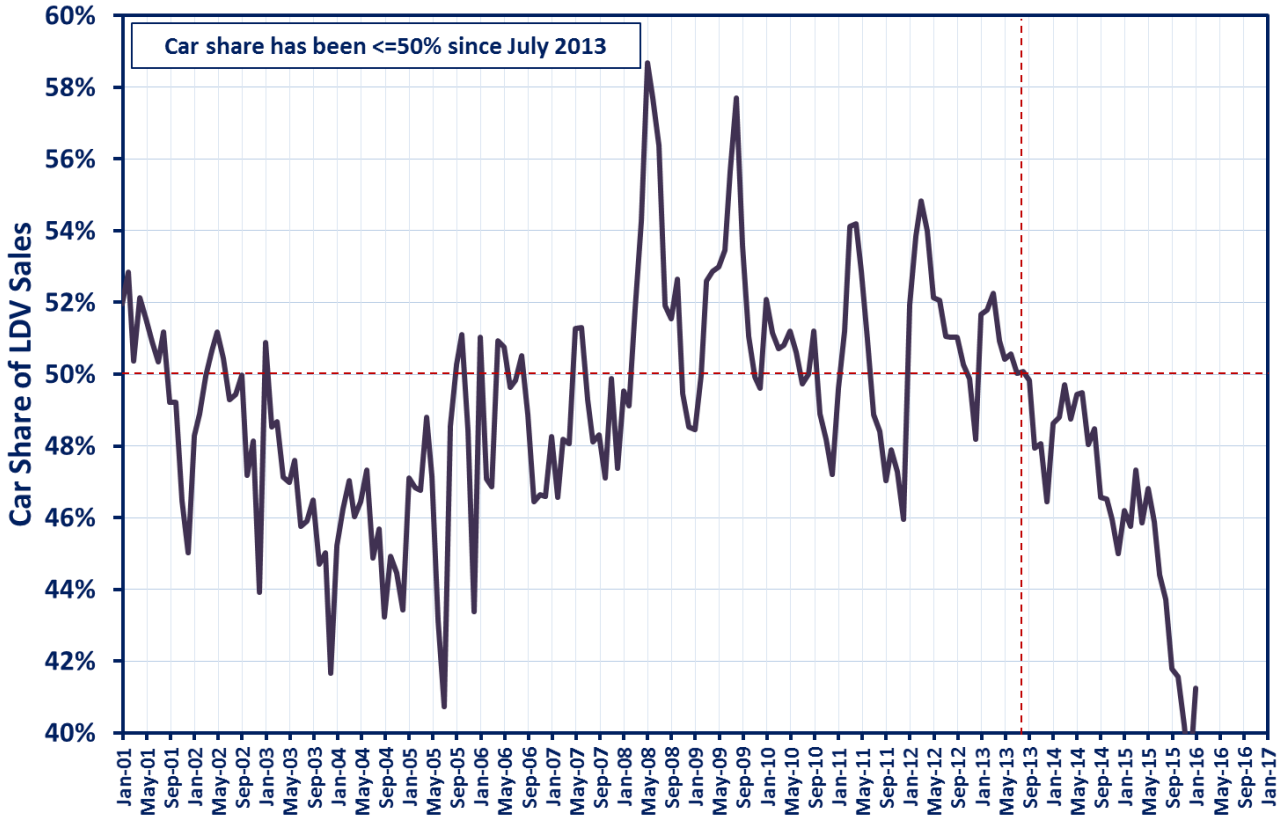
FOTW, ANL: Light-duty vehicle sales have continued an upward trend for five consecutive years



Source: http://energy.gov/eere/vehicles/fact-908-january-18-2016-light-vehicle-sales-rise-five-consecutive-years

LDV market

ANL: Light trucks continued to outsell cars in 2015

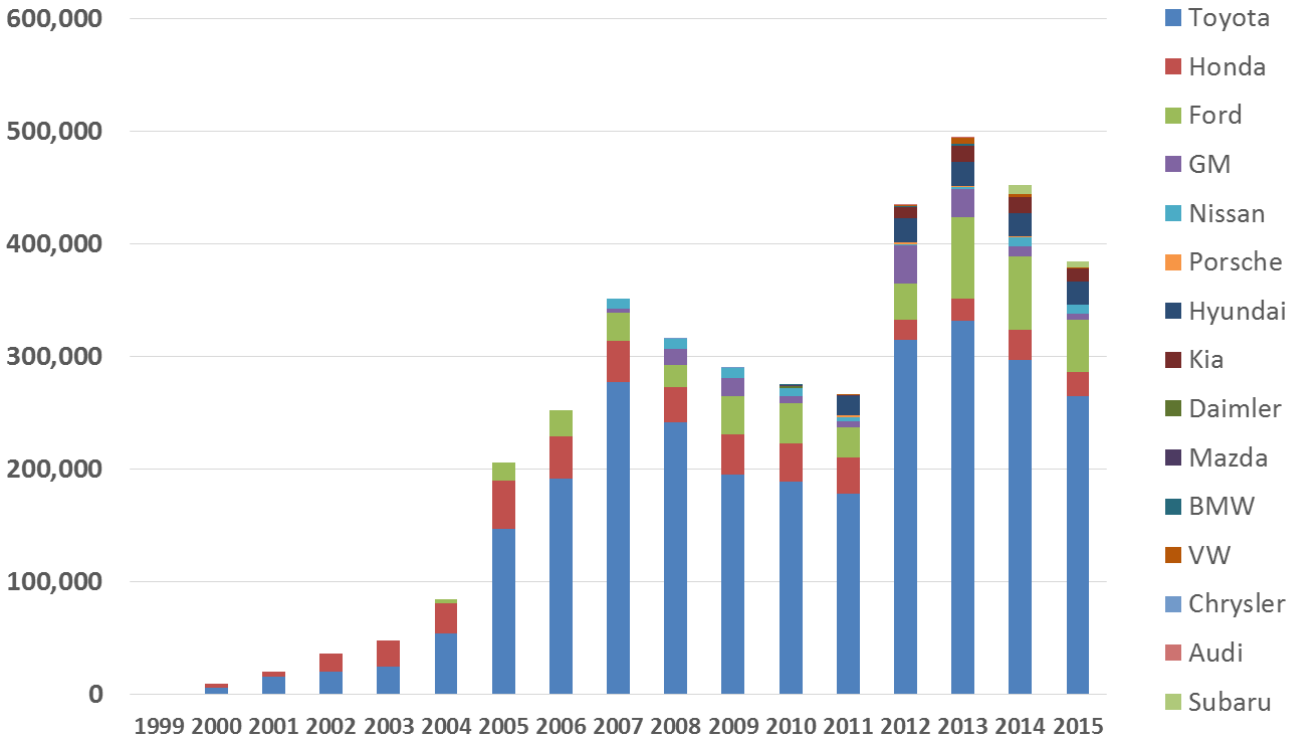


- Car share has been less than 50% since July 2013
- In 2015:
  Light trucks: 56%
  Cars: 44%

Source: Y. Zhou, Argonne National Laboratory

hybrid vehicle market

ANL: HEVs sales decline approximately 15% compared to 2014 levels

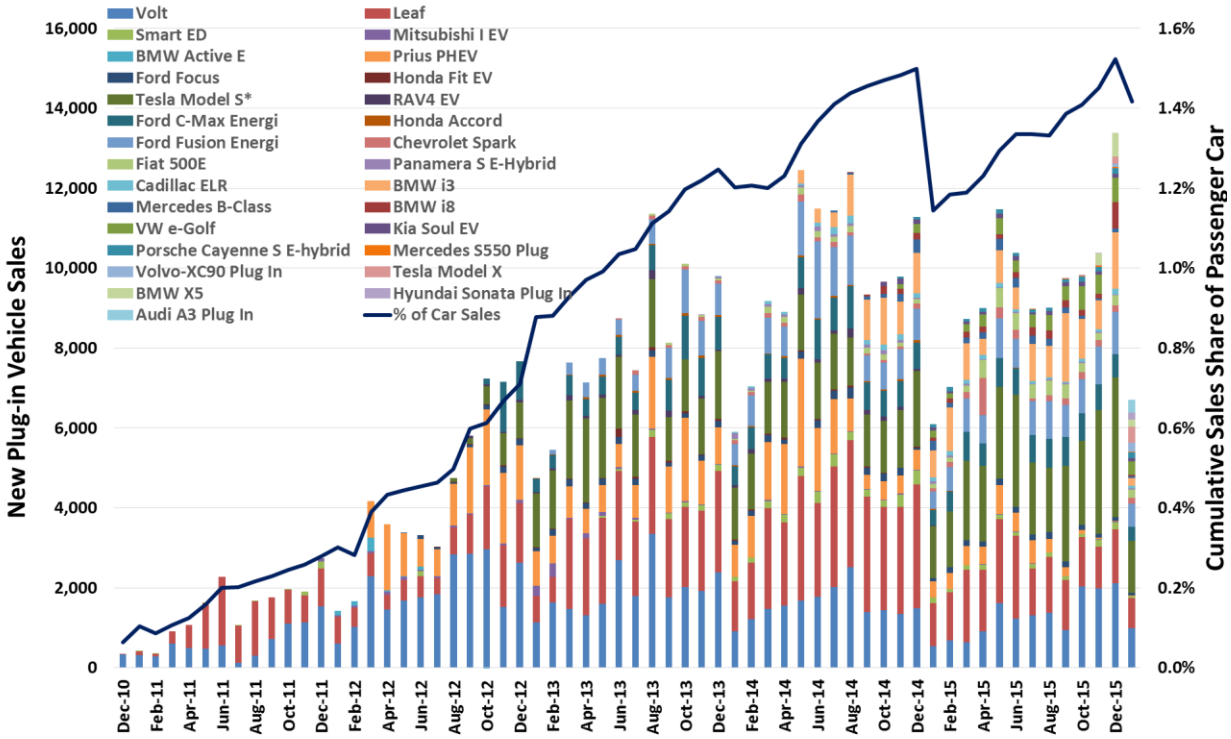


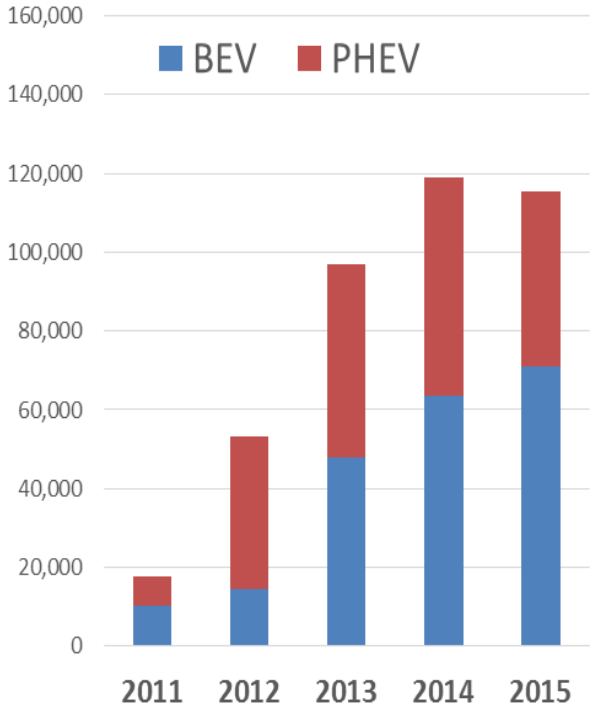
- Toyota accounts for 69% of annual HEV sales
- HEVs account for 2.2% of annual light duty vehicle sales.

Source: Y. Zhou, Argonne National Laboratory

EV market

ANL: U.S. PEV 2015 sales decline 3% from 2014 levels and comprise 1.5% of car sales (0.7% of all LDVs)

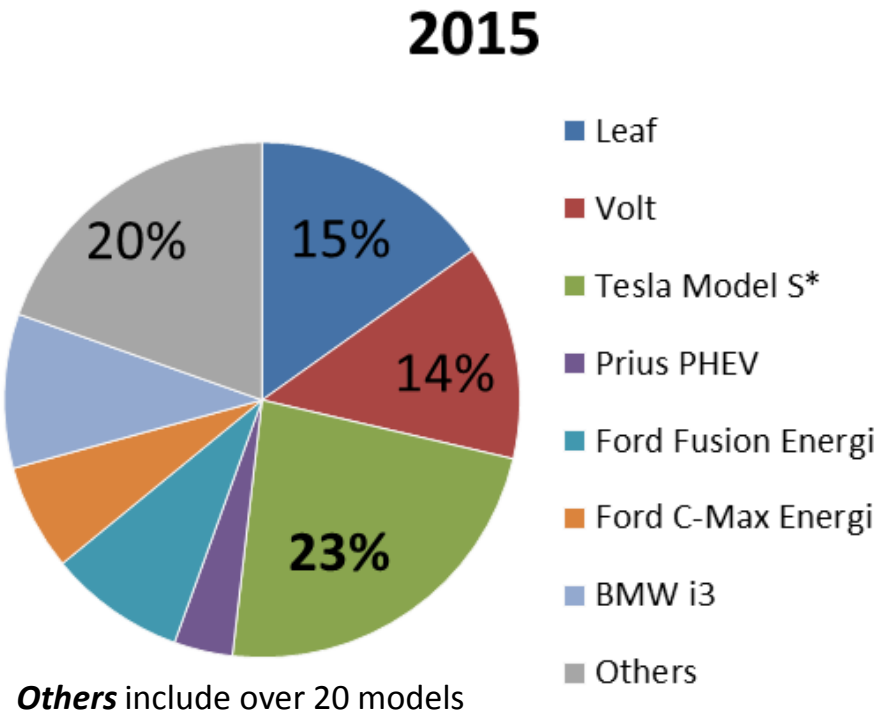




Source: Y. Zhou, Argonne National Laboratory

EV market

ANL: Tesla Model S, Nissan Leaf, and Chevy Volt are best selling PEV models in U.S. market in 2015



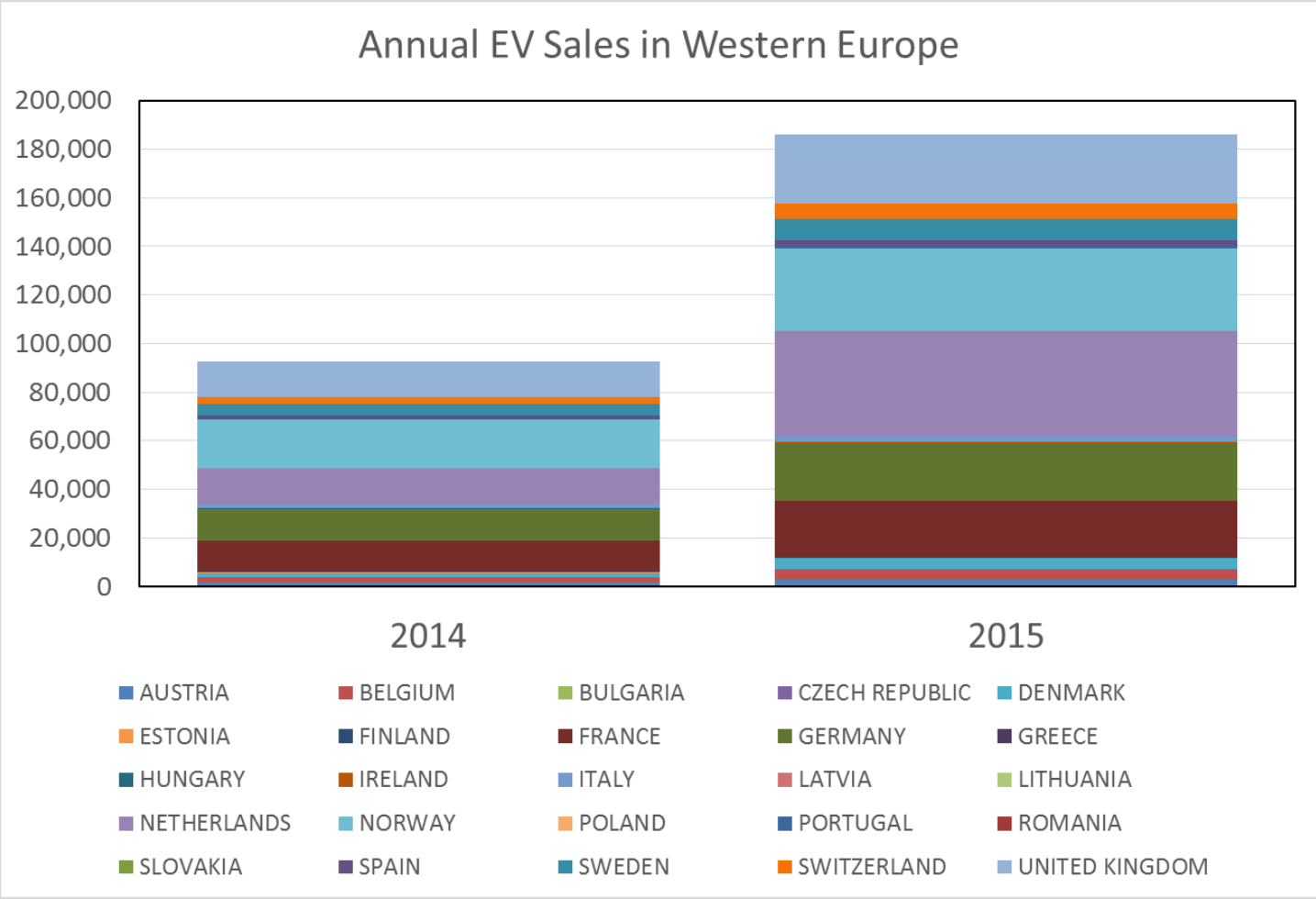
Others include over 20 models

- Model S had a best-ever result of 3,500 units in December.
- Tesla reached its annual goal of 50,000 units with actual global sales of 50,580.
- The lack of availability of the Prius PHEV and new Volt depressed the overall sales.
- New Volt is now fully available in the “launch” states with national availability due in the Spring.

Source: Y. Zhou, Argonne National Laboratory

EV market

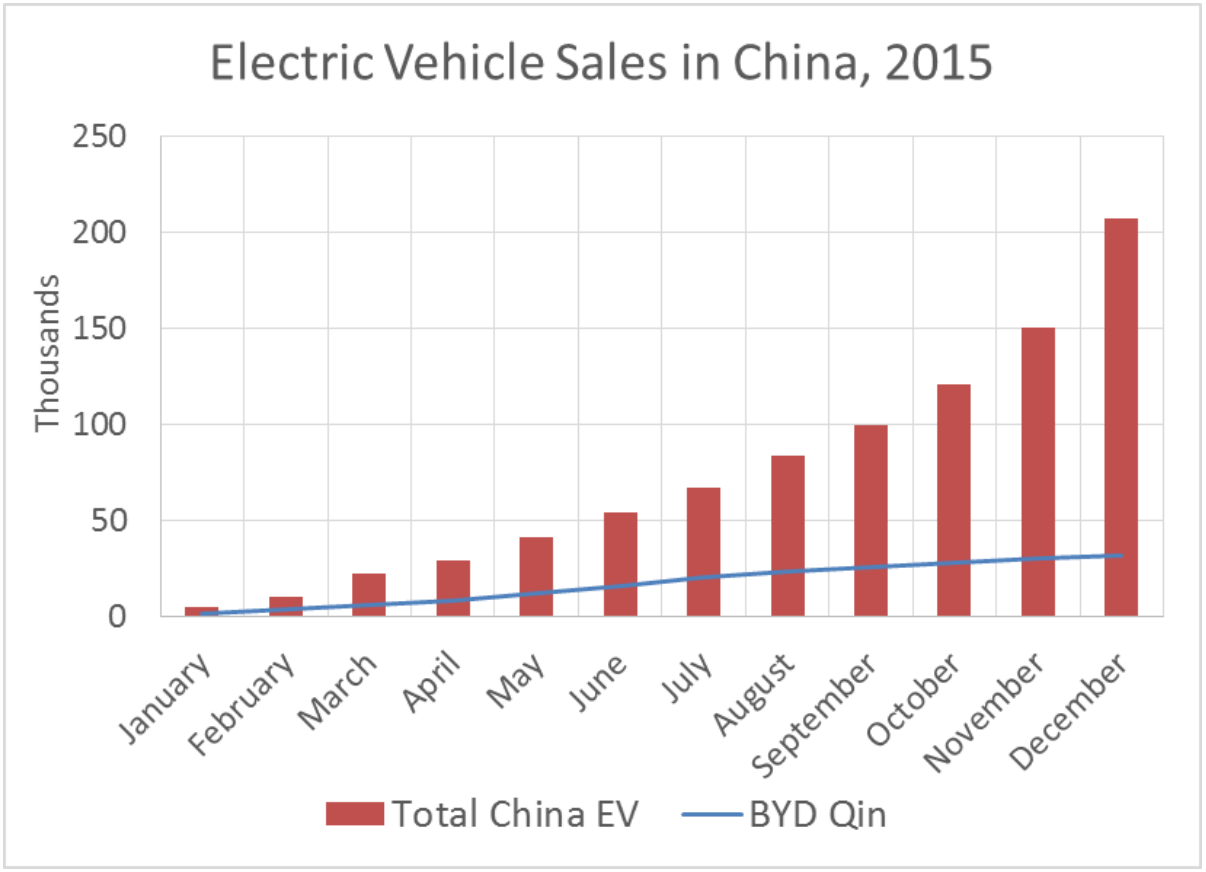
ACEA: EV sales are up (+100% vs. 2014) in Europe, accounting for 1.4% of overall sales



Source: http://www.acea.be/press-releases/article/alternative-fuel-vehicle-registrations-20.0-in-2015-21.1-in-q4

EV market

EV Sales: China is now the largest PEV market, with over 200,000 vehicles sold in 2015



Source: http://ev-sales.blogspot.com/search/label/China

EV market

Hybrid Cars: Tesla Model S ranks top-selling EV model worldwide; BYD top selling EV manufacturer

Tesla Model S: 50,366

Nissan Leaf: 43,870

Mitsubishi Outlander PHEV: 43,259

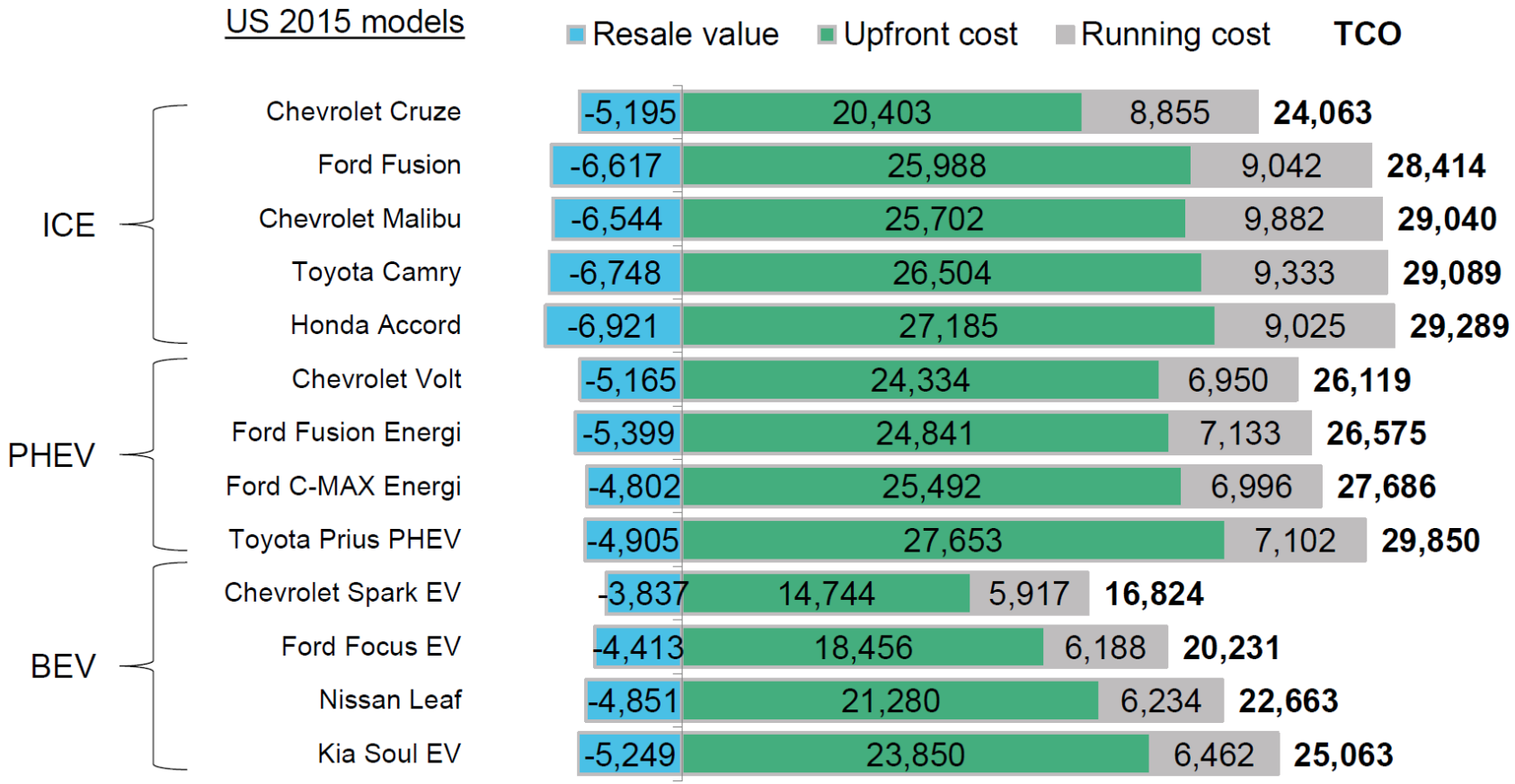
BYD Qin PHEV: 31,898

BMW i3: 24,083

Source: http://www.hybridcars.com/tesla-model-s-was-worlds-best-selling-plug-in-car-in-2015/ and http://ev-sales.blogspot.com/2016/01/world-top-20-december-2015-special.html

BEV markets

BNEF: Total cost of ownership for BEVs is as low as the cheapest ICEVs in United States, after incentives



Notes: Upfront cost includes down payment, financing and sales tax and is net of incentives; running costs consist of road tax, insurance, maintenance and fuel. Calculations assume 10,100 miles driven per year, $2.5/gallon cost of gasoline and $0.125/kWh cost of electricity.

Source: http://www.bcse.org/sustainableenergyfactbook/

topics

energy markets

automotive markets

3 technologies studies

environmental studies

consumers/opinion surveys

policy studies

qar

outline

3 technologies studies

vehicle performance

> EPA: Vehicles becoming more fuel-efficient and faster-accelerating

infrastructure

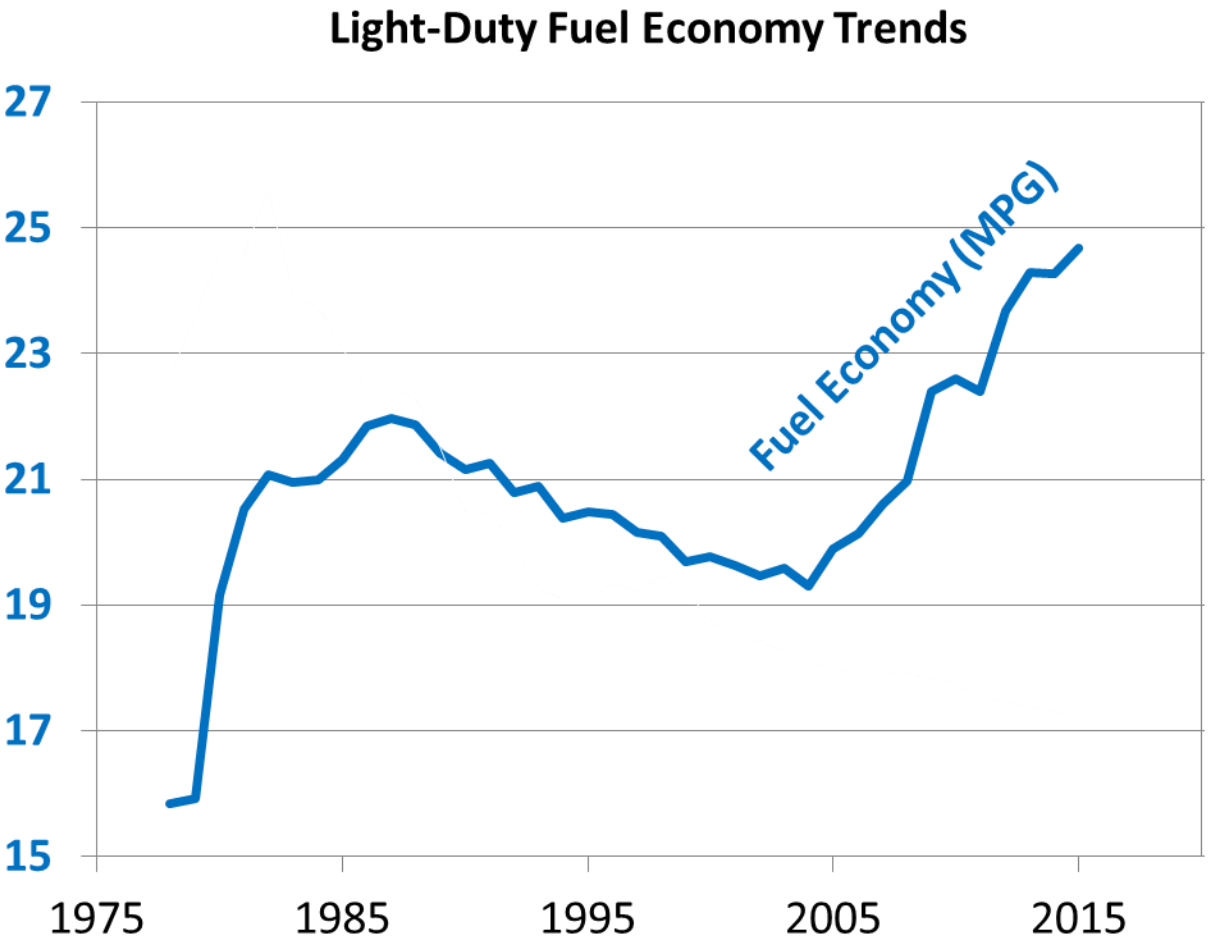
> AFDC: Number of alternative fueling stations growing
> FOTW/INL: Cost of EV supply equipment varies
> FOTW/INL: About 1/3 of EV charging done at work (for those with access to workplace charging)

rider habits

> NYC: Passengers hail cabs on the street and by computer/smartphone for different reasons

vehicle performance

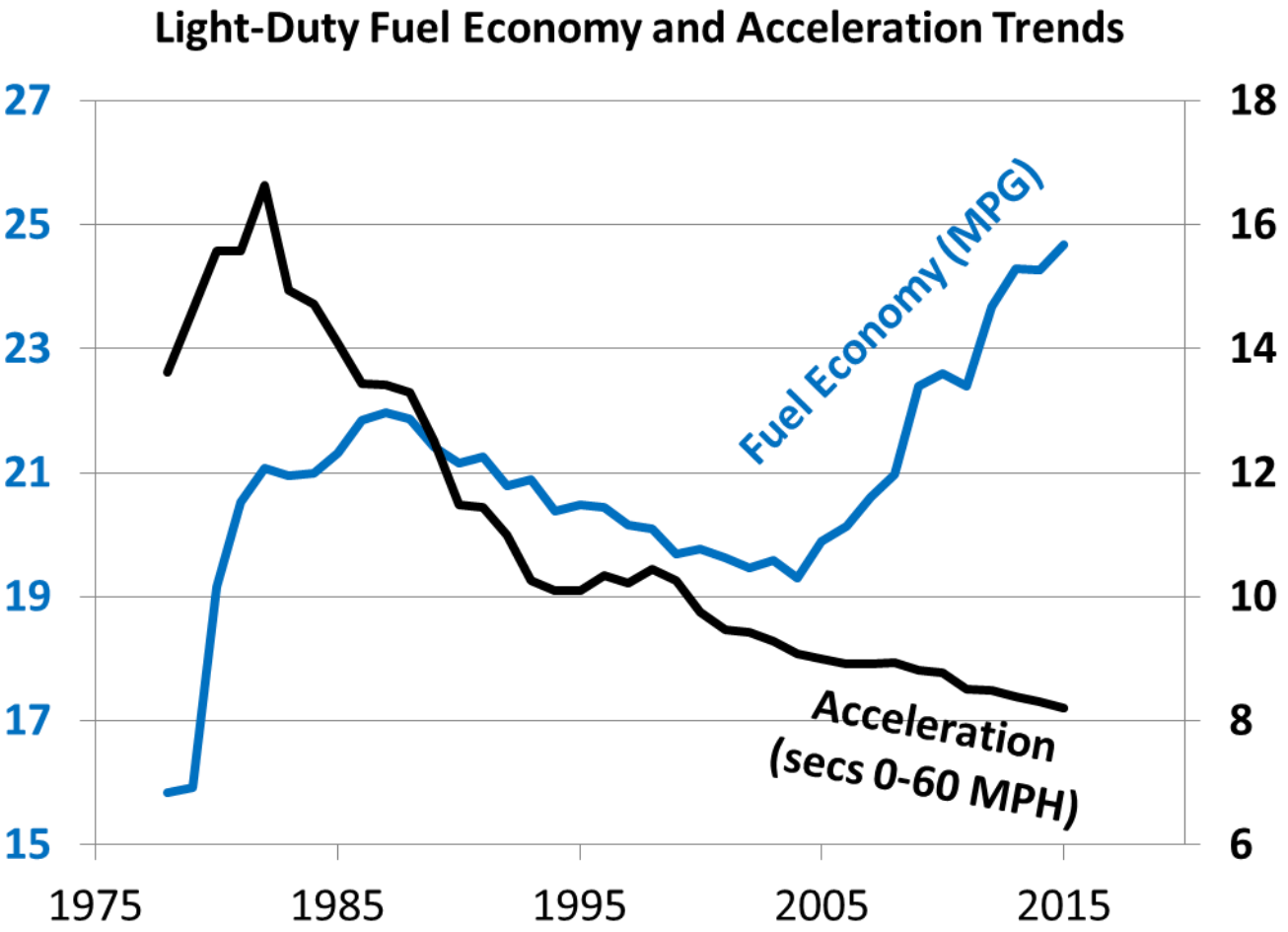
EPA: Light-duty fuel economy has improved over the past decade…



Source: United States Environmental Protection Agency, "Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends 1975-2015," December 2015, http://www3.epa.gov/otaq/fetrends-complete.htm#report

vehicle performance

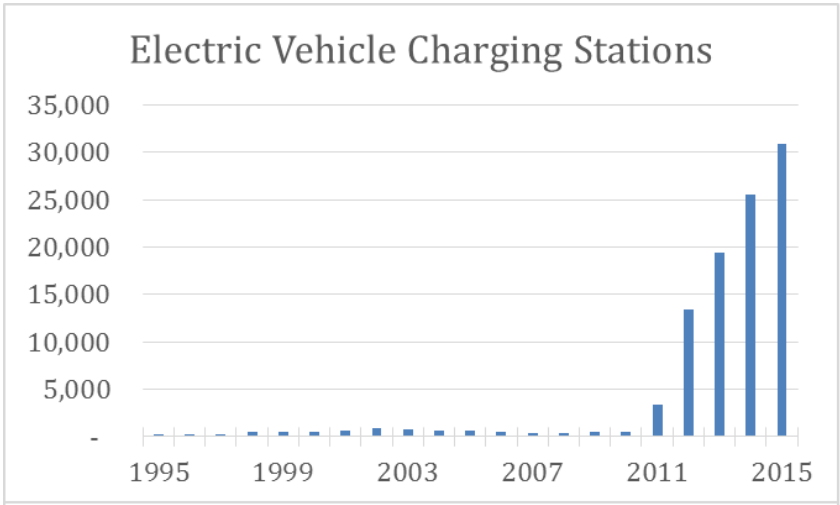
EPA: … and acceleration has been improving as well

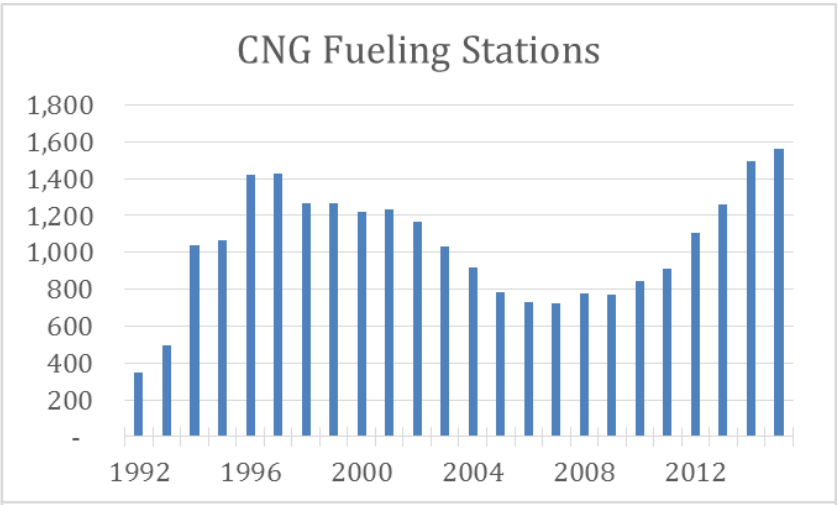


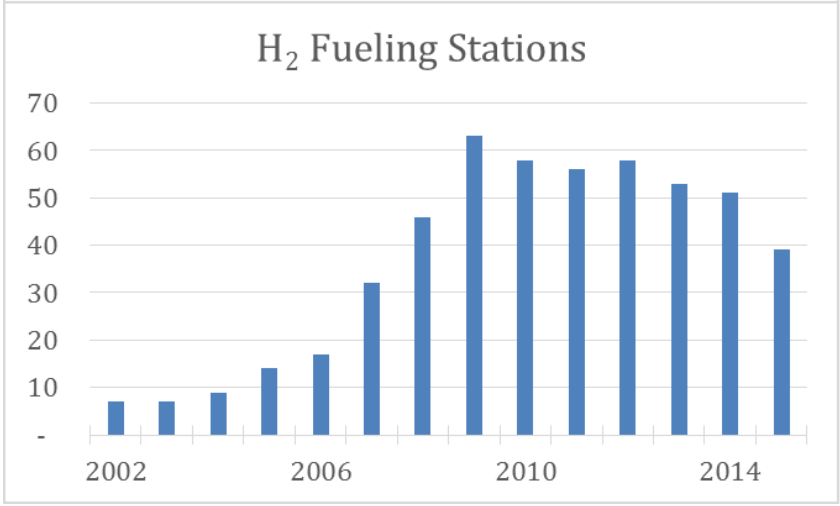
Source: United States Environmental Protection Agency, "Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends 1975-2015," December 2015, http://www3.epa.gov/otaq/fetrends-complete.htm#report

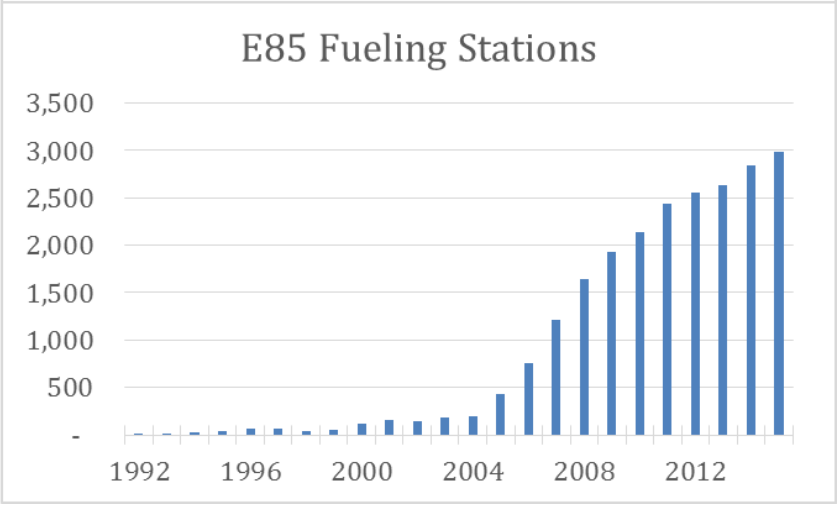
vehicle infrastructure

AFDC: Alternative fueling station availability growing, led by electric vehicle chargers





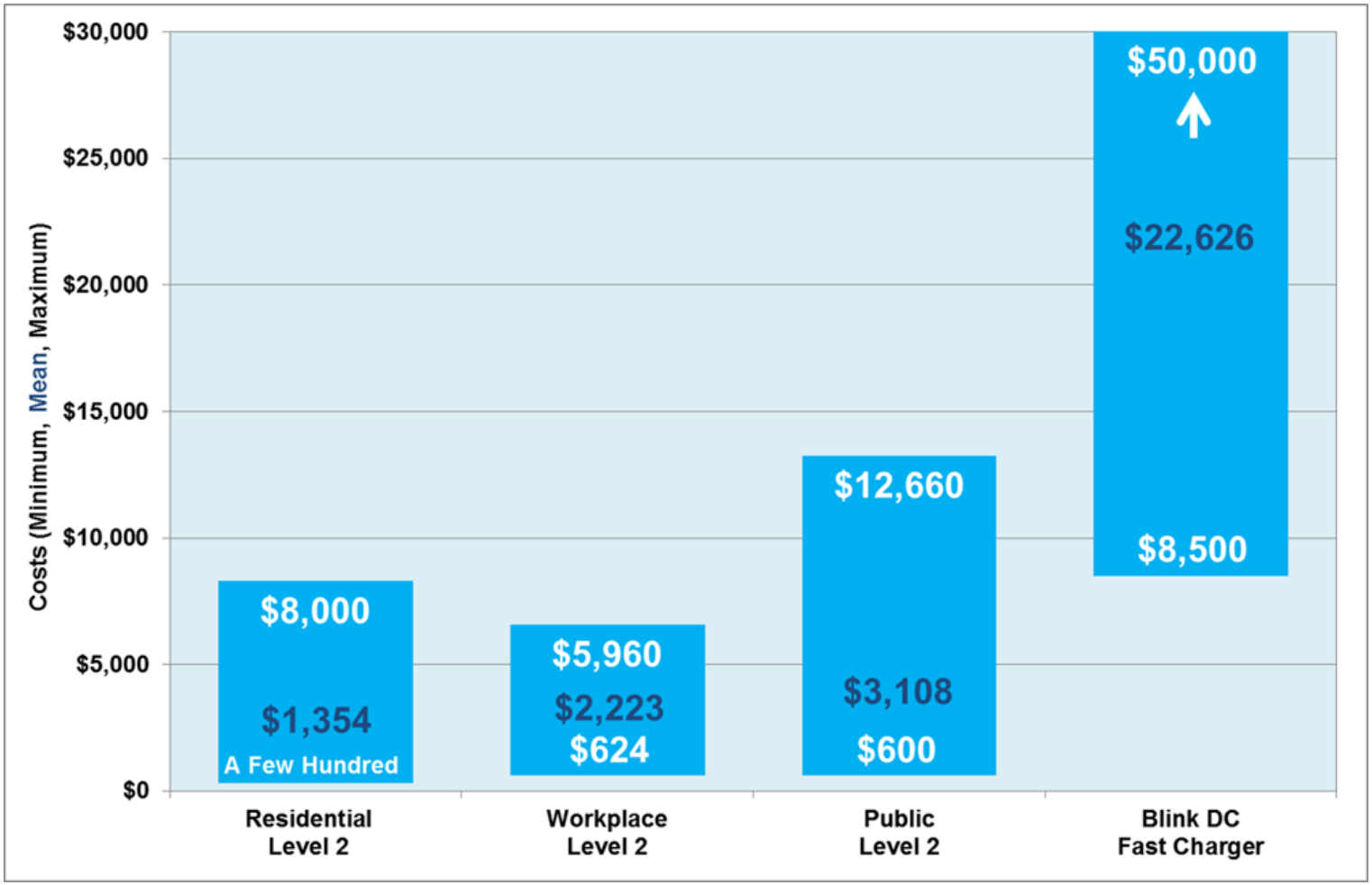




Source: http://www.afdc.energy.gov/data/10332

EV charging

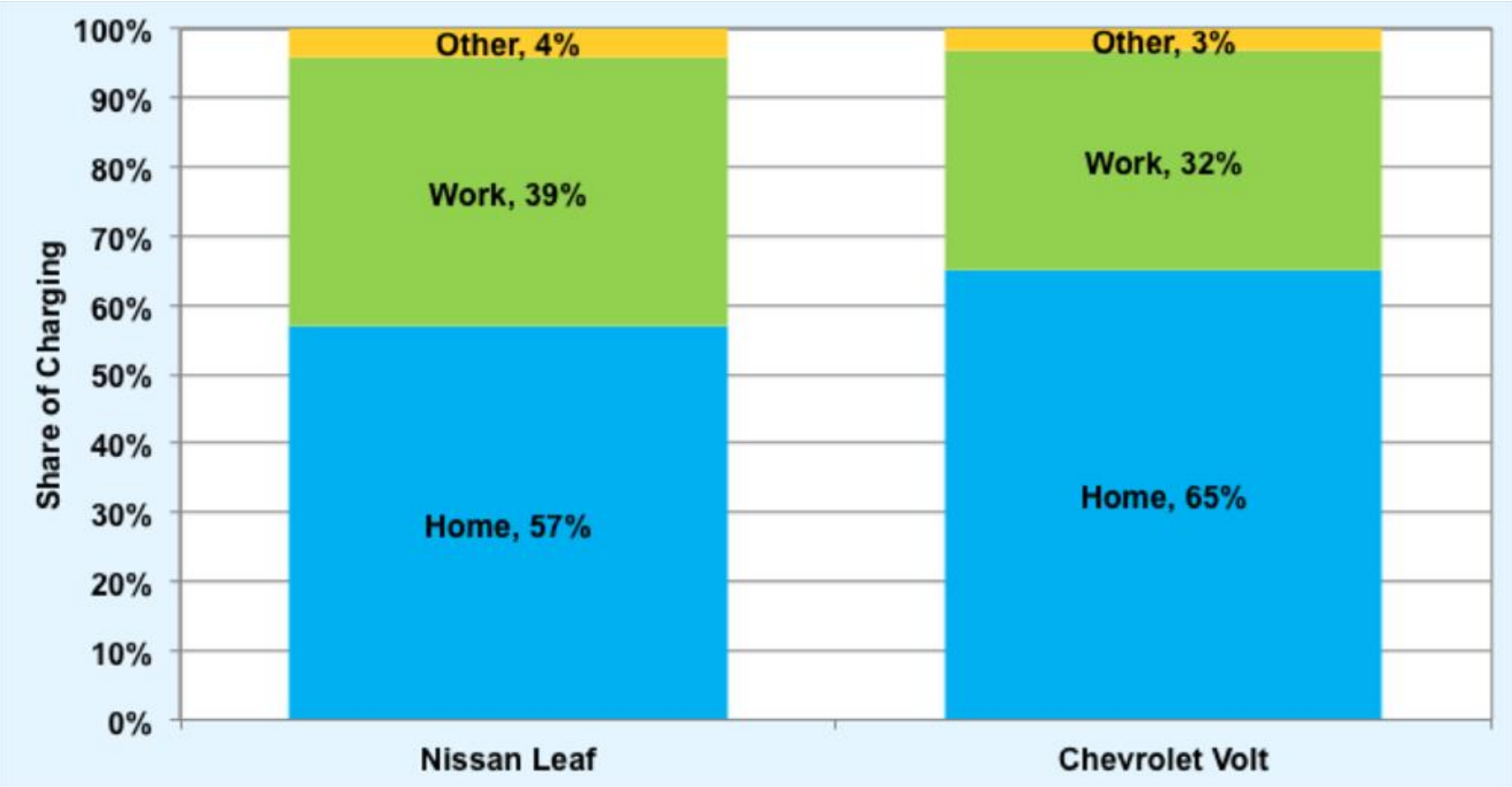
FOTW/INL: EVSE costs vary—sometimes greatly—for residential, workplace, and public chargers



Source: http://energy.gov/eere/vehicles/fact-910-february-1-2016-study-shows-average-cost-electric-vehicle-charger

EV charging

FOTW/INL: For those with workplace charging, ~1/3 of EV charging is done at work, according to EV Project



Source: http://energy.gov/eere/vehicles/fact-909-january-25-2016-workplace-charging-accounts-about-third-all-plug-vehicle

rider habits

NYC: E-dispatch and yellow cabs both offer convenience to riders, though different factors

Source: http://www1.nyc.gov/assets/operations/downloads/pdf/For-Hire-Vehicle-Transportation-Study.pdf

topics

energy markets

automotive markets

technologies studies

4 environmental studies

consumers/opinion surveys

policy studies

qar

outline

4 environmental studies

emissions

> Economist: CO_2 emissions lower in 2015
> FOTW: Alternative fuels playing a larger role in transit

freight

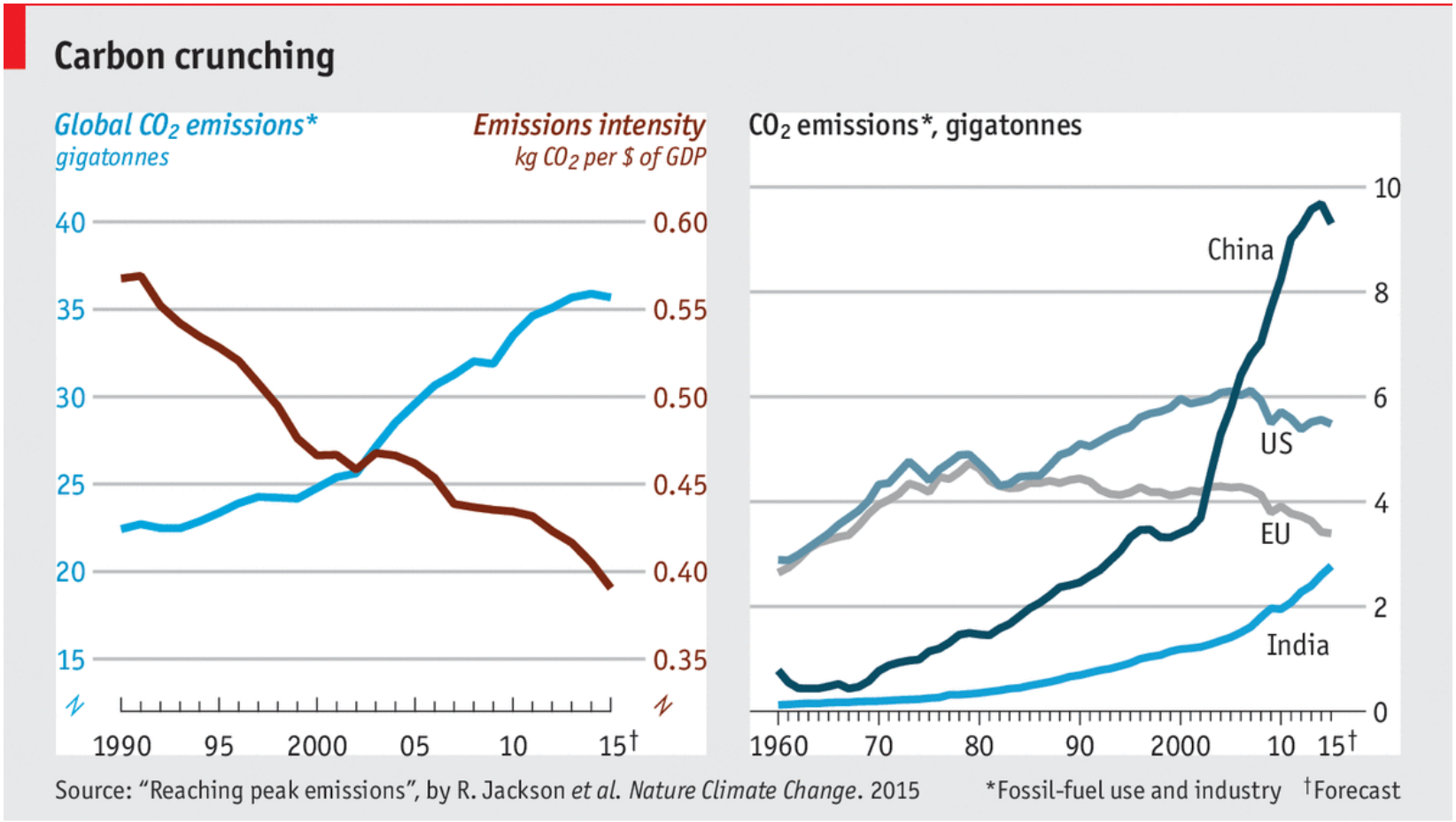
> DOT: Freight mode differs for heavier and more valuable goods
> DOT: Long haul trucking projected to increase to 2040

traffic

> DOT: Peak-period congestion will exist on many national highways by 2040

emissions

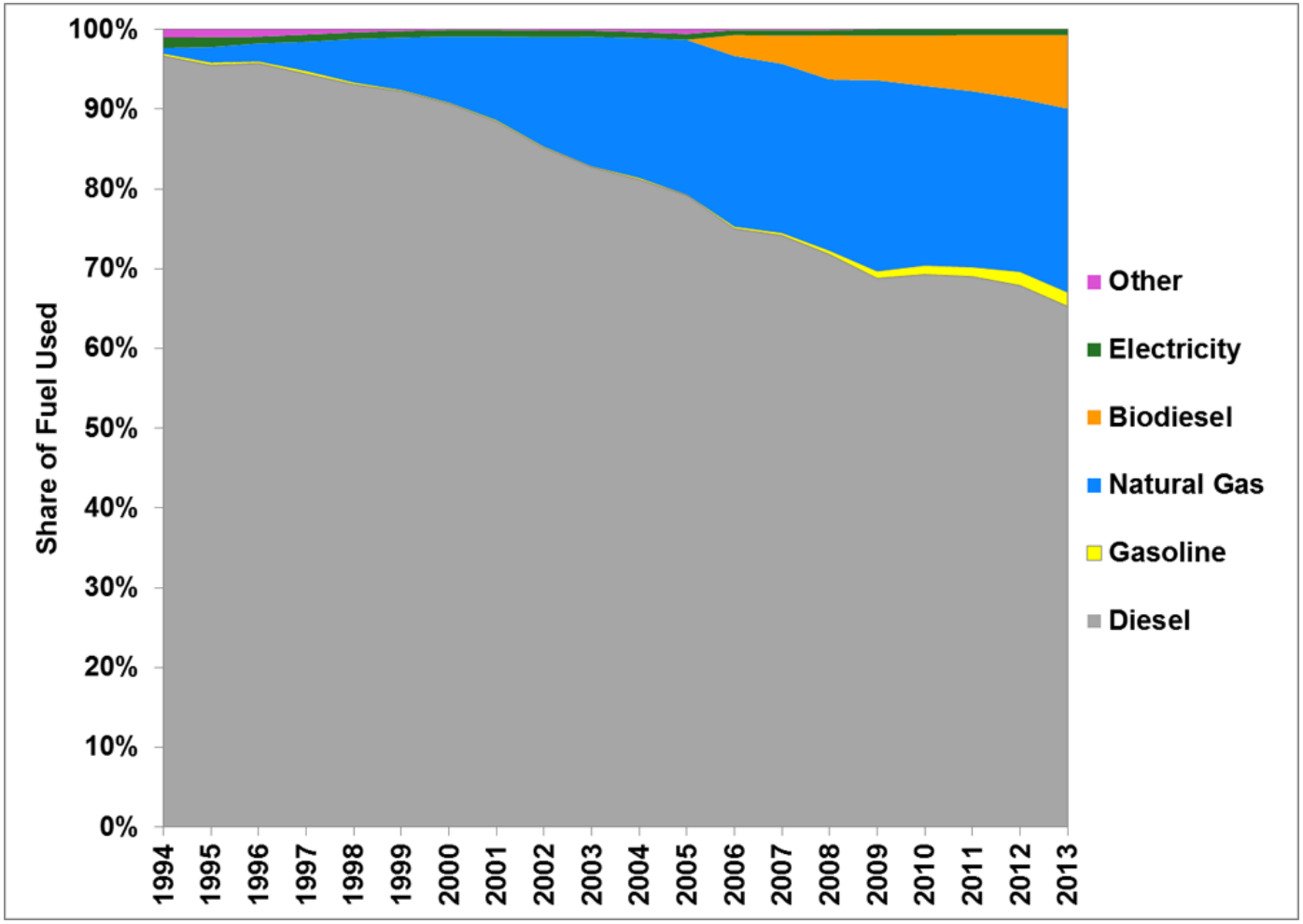
Economist: Global CO_2 emissions may have peaked in 2014



Source: http://www.economist.com/blogs/graphicdetail/2015/12/climate-change and http://www.nature.com/nclimate/journal/v6/n1/full/nclimate2892.html

fuel choice

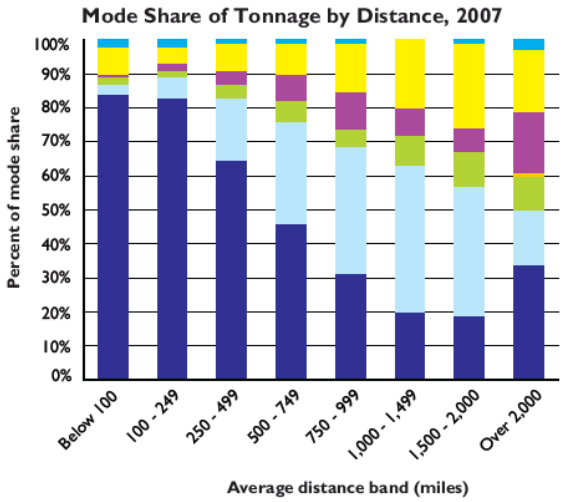
FOTW: Alternative fuels continue to make up a larger portion of transit bus fuel use

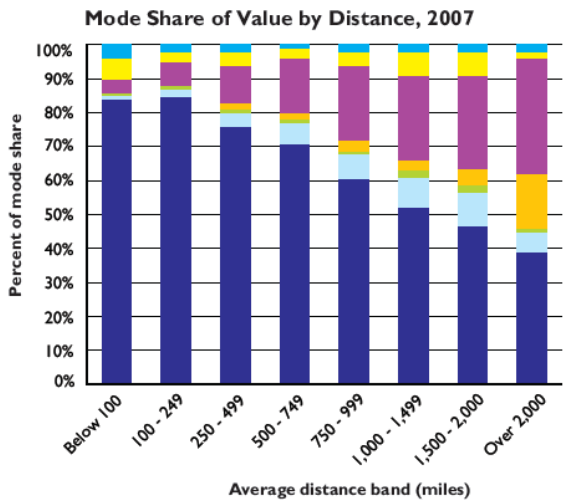


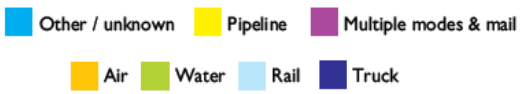
Source: http://energy.gov/eere/vehicles/fact-905-december-28-2015-alternative-fuels-account-one-third-transit-bus-fuel-use

freight modes

DOT RITA: Freight mode—measured in tonnage and in value—varies by distance travelled







Weight	Millions of tons
Gravel	2,427
Cereal grains	1,665
Non-metallic mineral products	1,514
Waste/scrap	1,441
Natural gas, coke, asphalt[1]	1,403
Coal	1,263
Gasoline	1,029
Crude petroleum	839
Fuel oils	757
Natural sands	620
Total, all commodities	**20,063**

Value	Billions of 2007 dollars
Machinery	$1,877
Electronics	$1,485
Motorized vehicles	$1,484
Mixed freight	$1,110
Pharmaceuticals	$914
Gasoline	$796
Miscellaneous manufactured products	$740
Textiles/leather	$736
Natural gas, coke, asphalt[1]	$650
Plastics/rubber	$618
Total, all commodities	**$17,983**

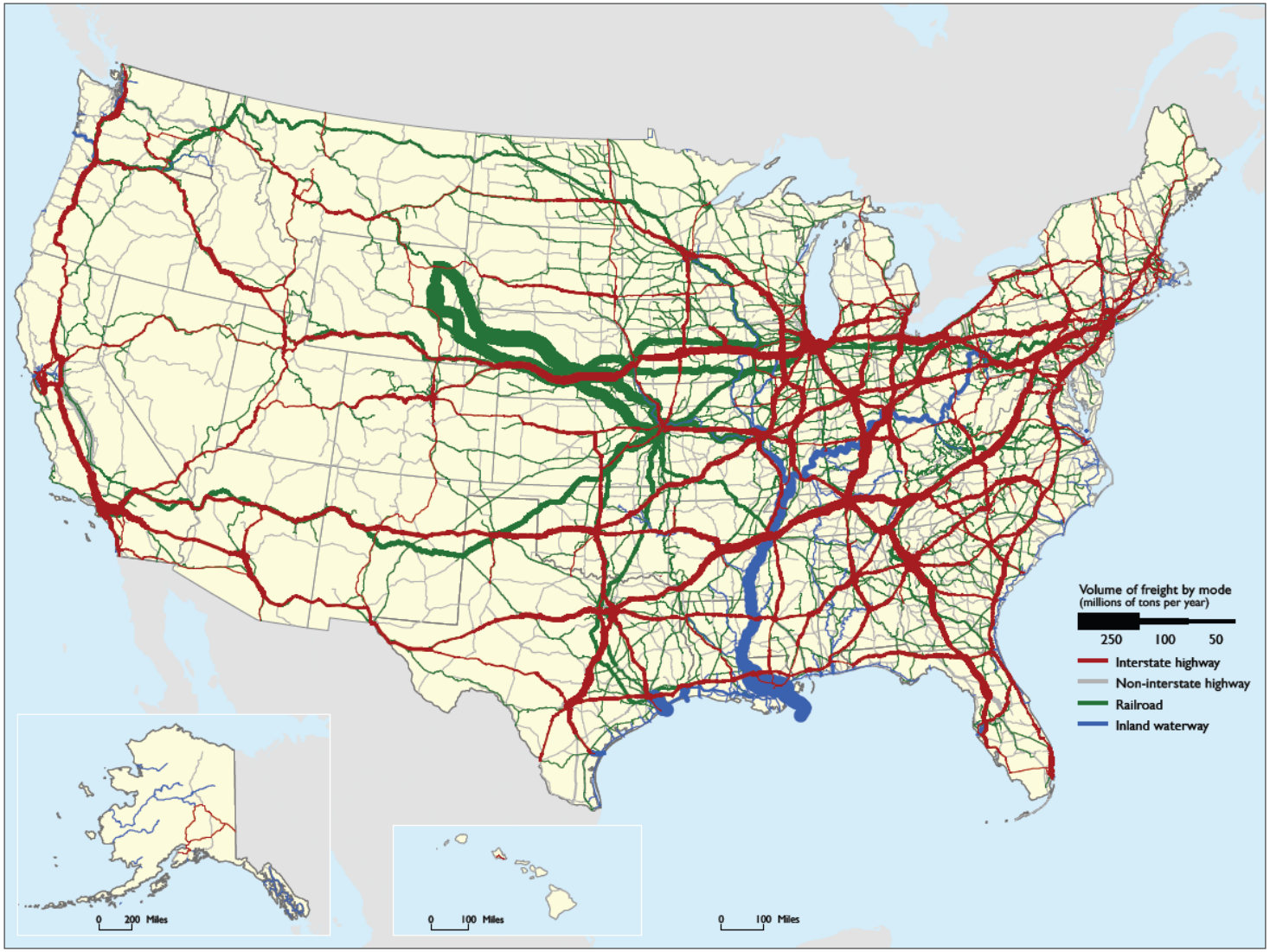
[1]This group includes coal and petroleum products not elsewhere classified such as liquefied natural gas, coke, asphalt, and other products of coal and petroleum refining, excluding gasoline, aviation fuel, and fuel oil.

- High-value items travel by air, truck, and across multiple modes
- Water, pipeline, and rail transport relatively low-value freight

Source: http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/data_and_statistics/by_subject/freight/freight_facts_2015, 2007 data

freight modes

DOT RITA: Different freight modes used across country

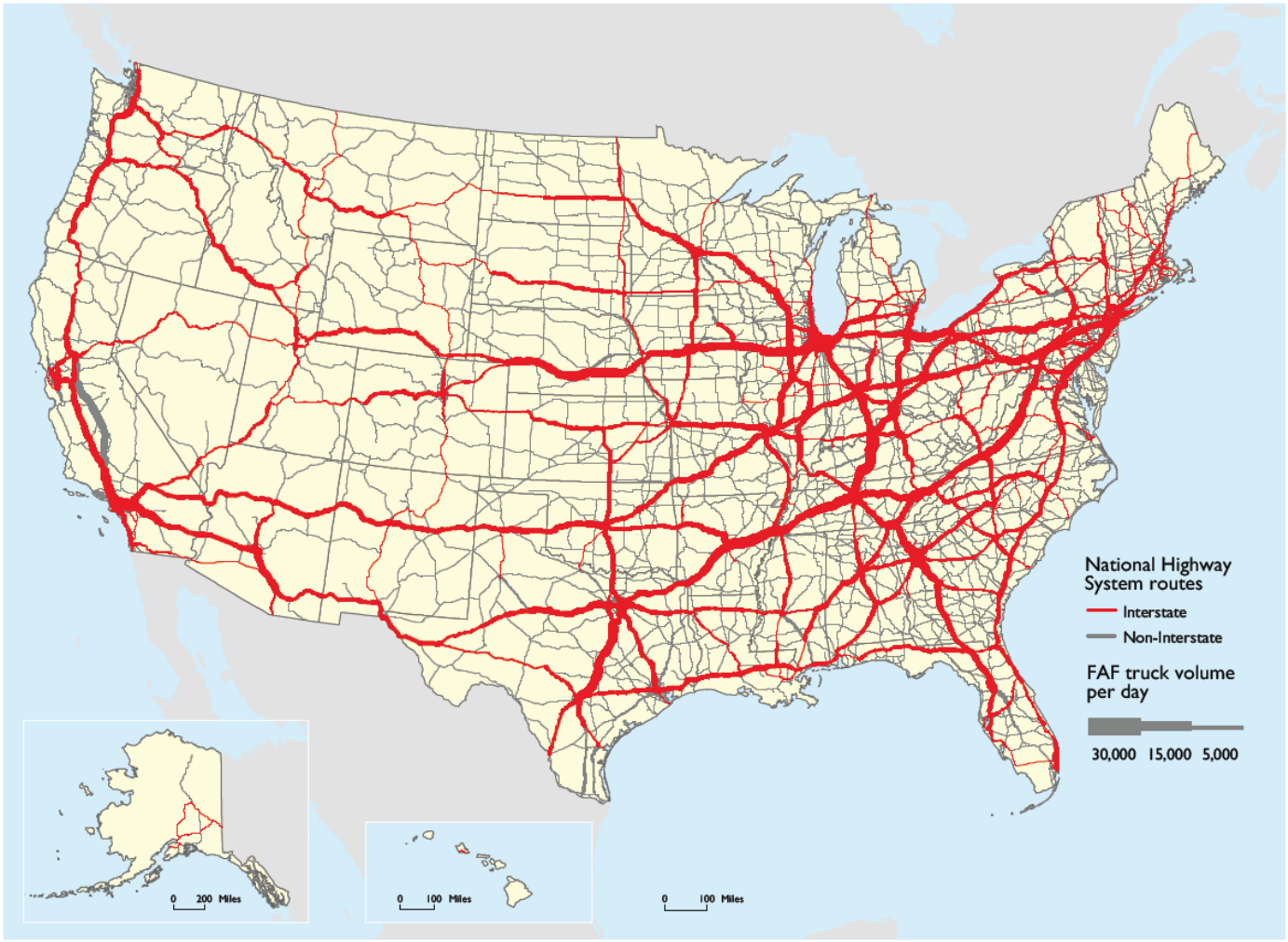


Source: http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/data_and_statistics/by_subject/freight/freight_facts_2015, 2011 data

freight modes

DOT RITA: Long-haul trucks mostly on interstates…

Figure 3-5 Average Daily Long-Haul Truck Traffic on the National Highway System: 2011

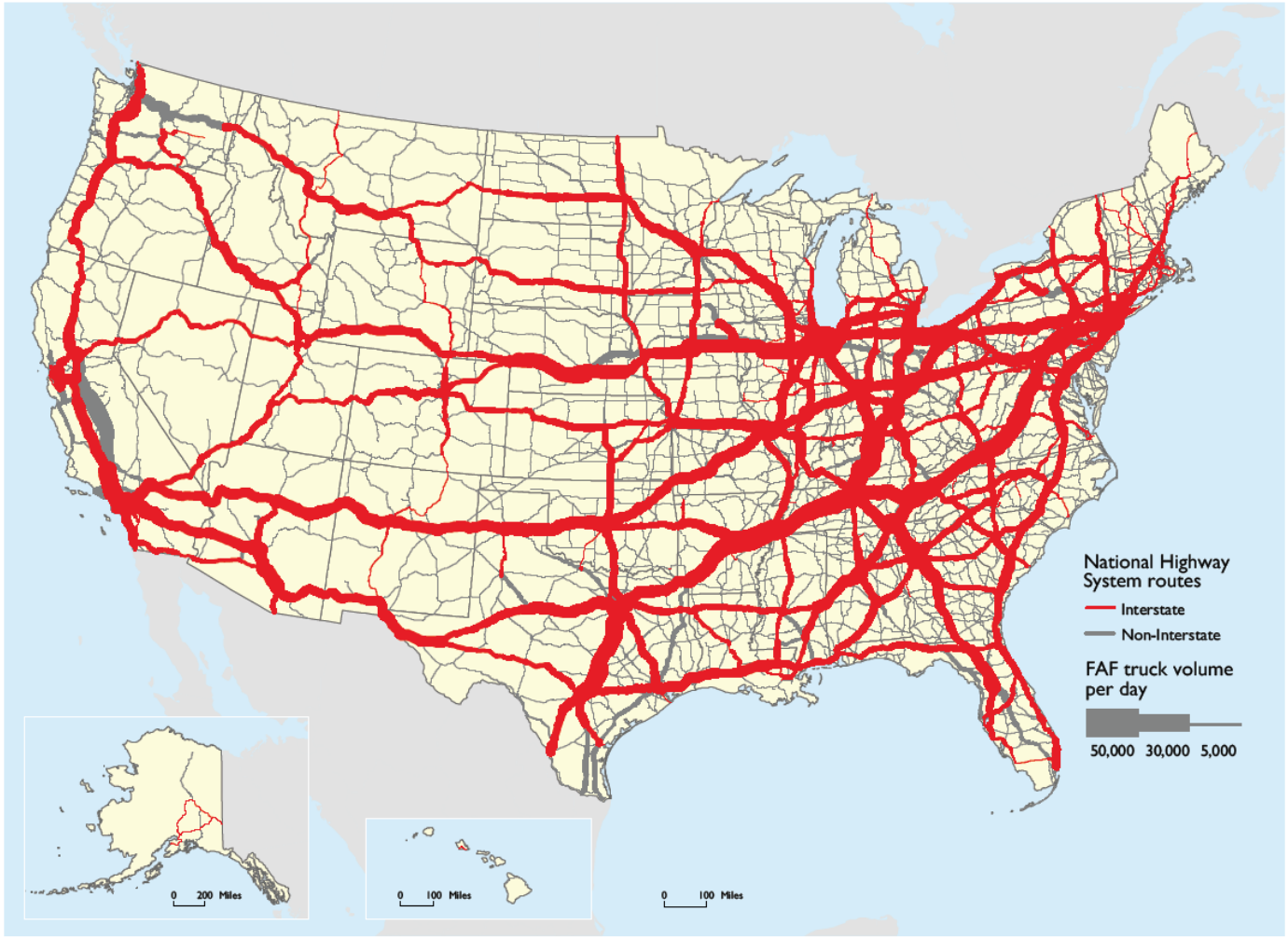


Source: http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/data_and_statistics/by_subject/freight/freight_facts_2015, 2011 data

freight modes

DOT RITA: … and expected to grow over next 30 years

Figure 3-6 Average Daily Long-Haul Truck Traffic on the National Highway System: 2040

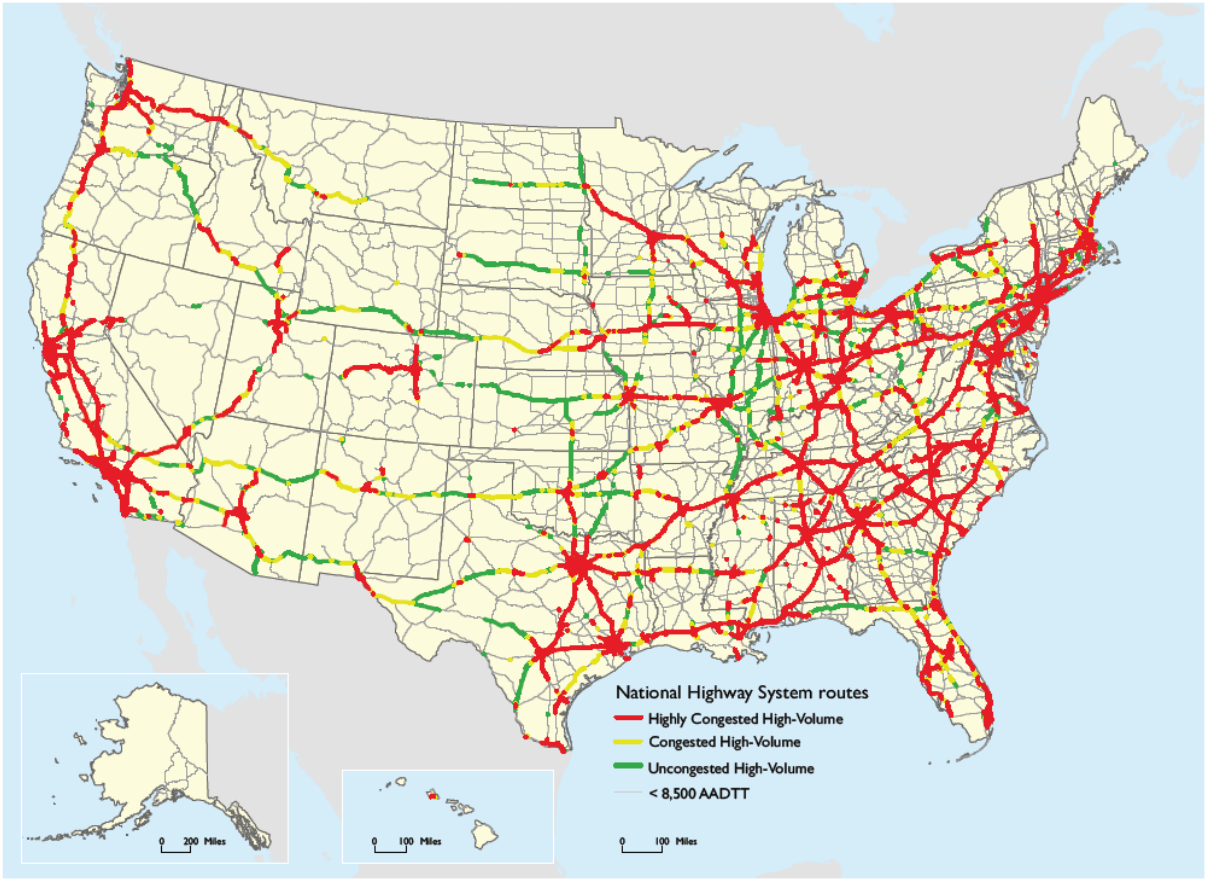


Source: http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/data_and_statistics/by_subject/freight/freight_facts_2015, 2040 projections

traffic

DOT RITA: Peak-period congestion projected on many roads in national highway system in 2040

Figure 4-5 Peak-Period Congestion on High-Volume Truck Portions of the National Highway System: 2040



Source: http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/data_and_statistics/by_subject/freight/freight_facts_2015, 2040 projections

topics

energy markets

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technologies studies

environmental studies

5 consumers/opinion surveys

policy studies

qar

outline

5 consumer & opinion surveys

polling behavior

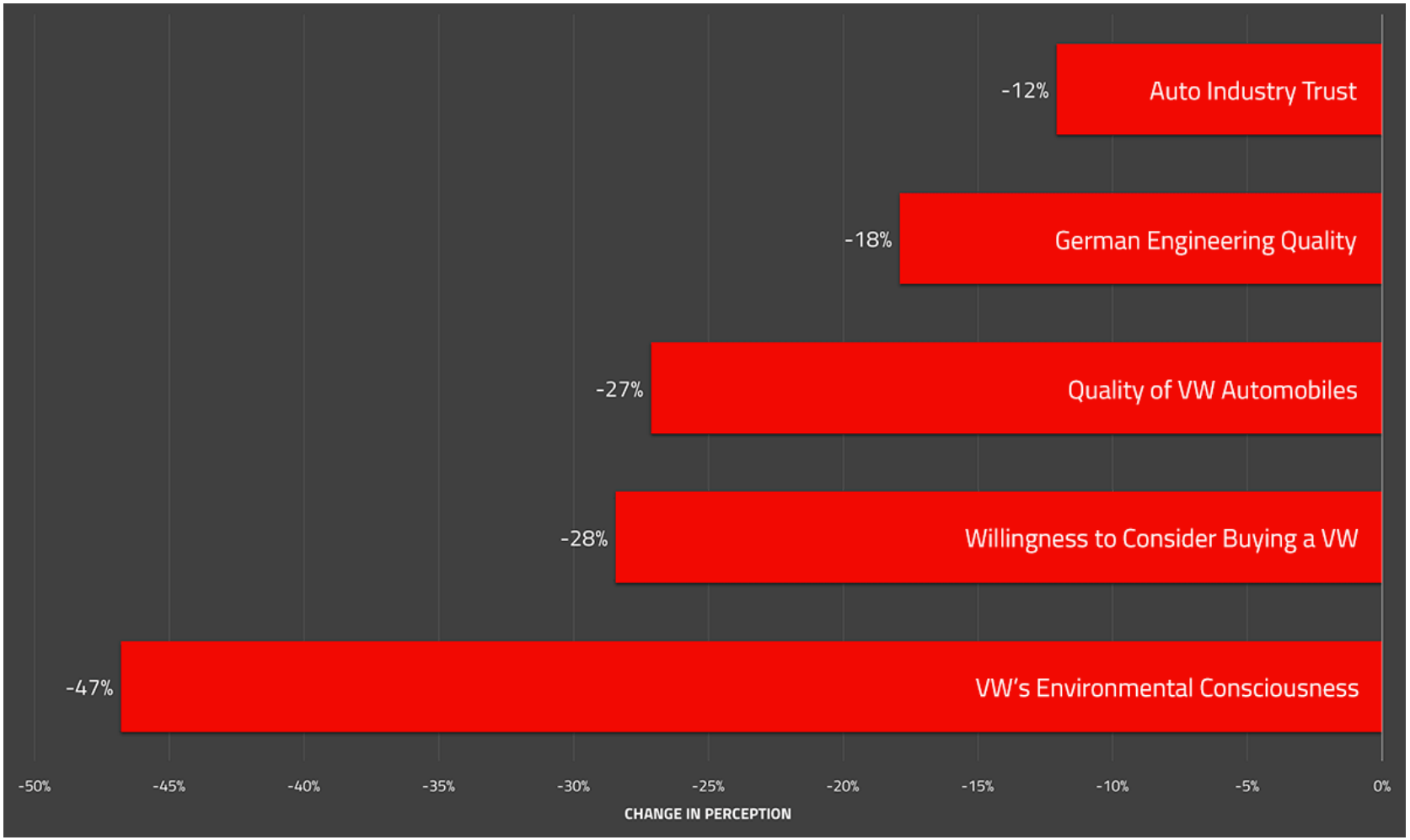
> Autolist: Consumers view VW less favorably than before
> NREL: People who are aware of EVSE view EVs more favorably
> TTI: Mixed opinions towards self-driving vehicles

travel behavior

> FOTW/INL: Electric-charged miles driven similar for Nissan Leaf and Chevy Volt
> FOTW: Vehicle miles travelled (VMT) again increasing year-over-year; highest in summer
> CBO: While VMT increasing, lane-miles in U.S. steady since 1980
> FOTW: VMT higher when gasoline prices are lower

VW emissions scandal

Autolist: Volkswagen emissions scandal has hurt consumer perceptions of VW and auto industry



Source: http://www.autolist.com/volkswagen-jetta-boston-ma#section=vw-consumer-survey

CAVs sentiments

TTI: Trust, safety, and cost top list of reasons not to use a self-driving vehicle (accounts for ~90% of responses)

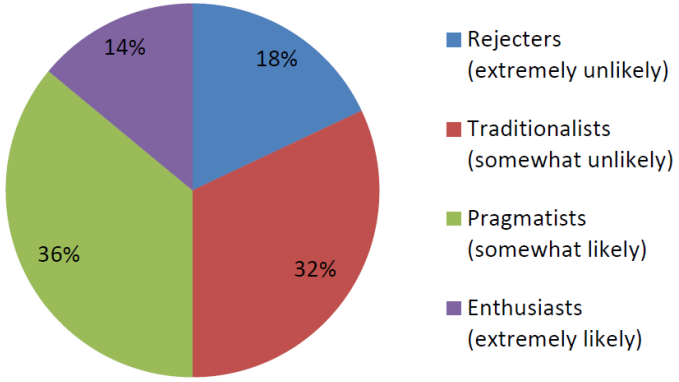


Figure 2. Intent to Use Self-Driving Vehicles (N=556).

Table 2. Intent to Use Self-Driving Vehicles by Age.

Segment	Less than 30 Years Old (n=132)	30–45 Years Old (n=155)	46–65 Years Old (n=167)	65+ Years Old (n=102)
Rejecters (extremely unlikely)	24%	14%	22%	15%
Traditionalists (somewhat unlikely)	26%	33%	33%	35%
Pragmatists (somewhat likely)	39%	36%	32%	36%
Enthusiasts (extremely likely)	11%	17%	13%	14%
Total	100%	100%	100%	100%

Table 3. Reasons for Not Intending to Use Self-Driving Vehicles.

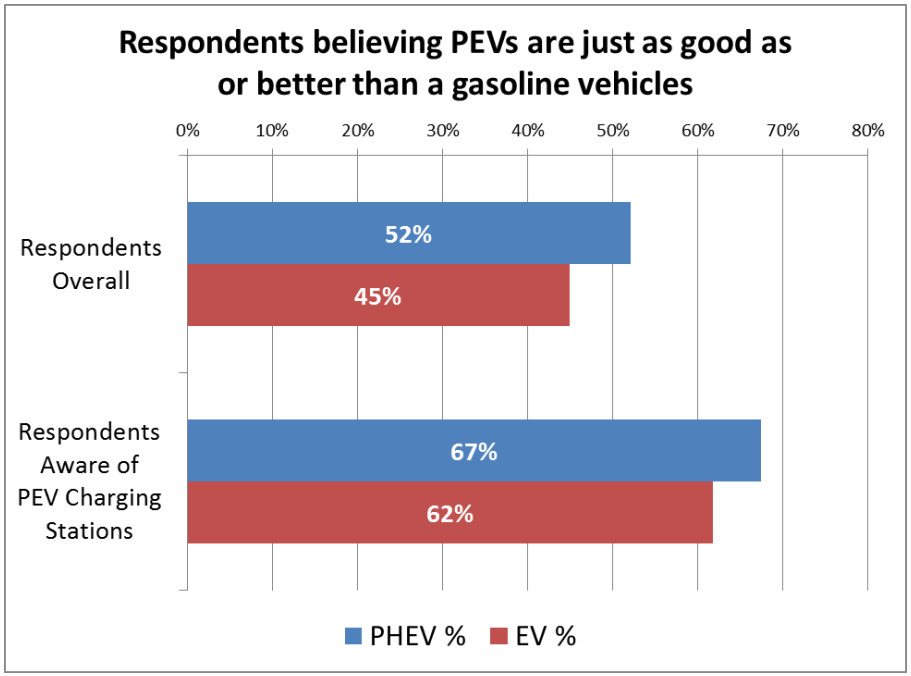
Reason	Frequency	Percent	Cumulative Percent
Lack of trust in this technology	117	41%	41%
Safety concerns	69	24%	65%
Cost concerns	61	22%	87%
Like to drive	20	7%	94%
Desire for control of vehicle	6	2%	96%
Insurance/liability uncertainties	2	1%	97%
Anti-technology in general	2	1%	98%
Lack of information about it	2	1%	99%
No need for it	2	1%	100%
	282	100%	

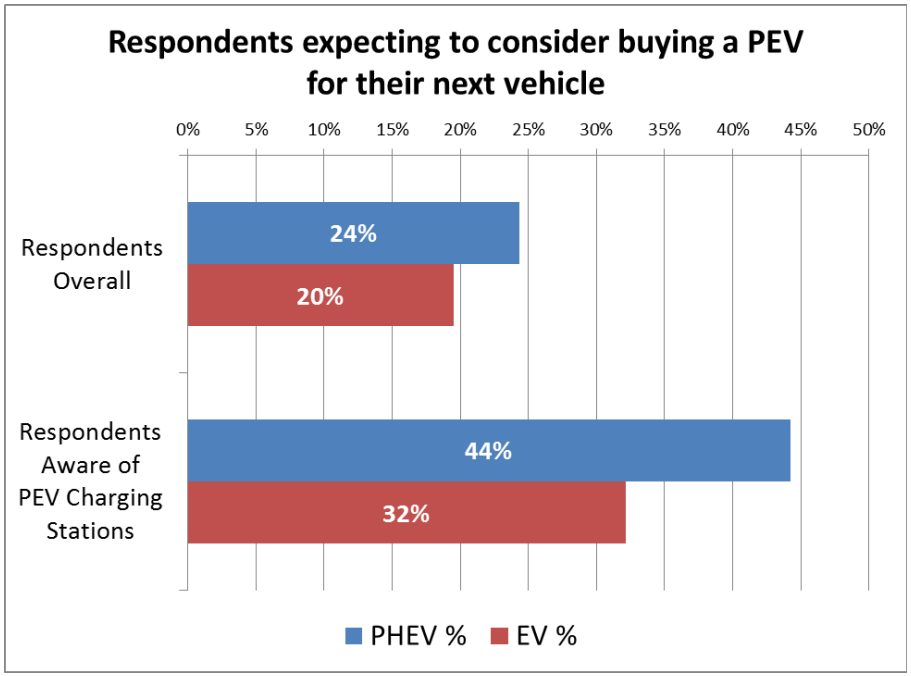
- Males, more than females, are likely to use, and 18 percent of males were Enthusiasts, compared to 11 percent of females.
- Most of those with a household income less than $25,000 were unlikely to use (56%), while those earning $25,000–$50,000 were more likely to use (54%).
- Educational attainment was not associated with intent to use.
- Households with children were less likely to indicate intent to use than households without children (51% and 45%).

Source: Consumer Acceptance and Travel Behavior Impacts of Automated Vehicles, http://tti.tamu.edu/documents/PRC-15-49-F.pdf

driver habits

NREL: People who are aware of PEV charging equipment are more likely to view PEVs positively and more likely to consider purchasing



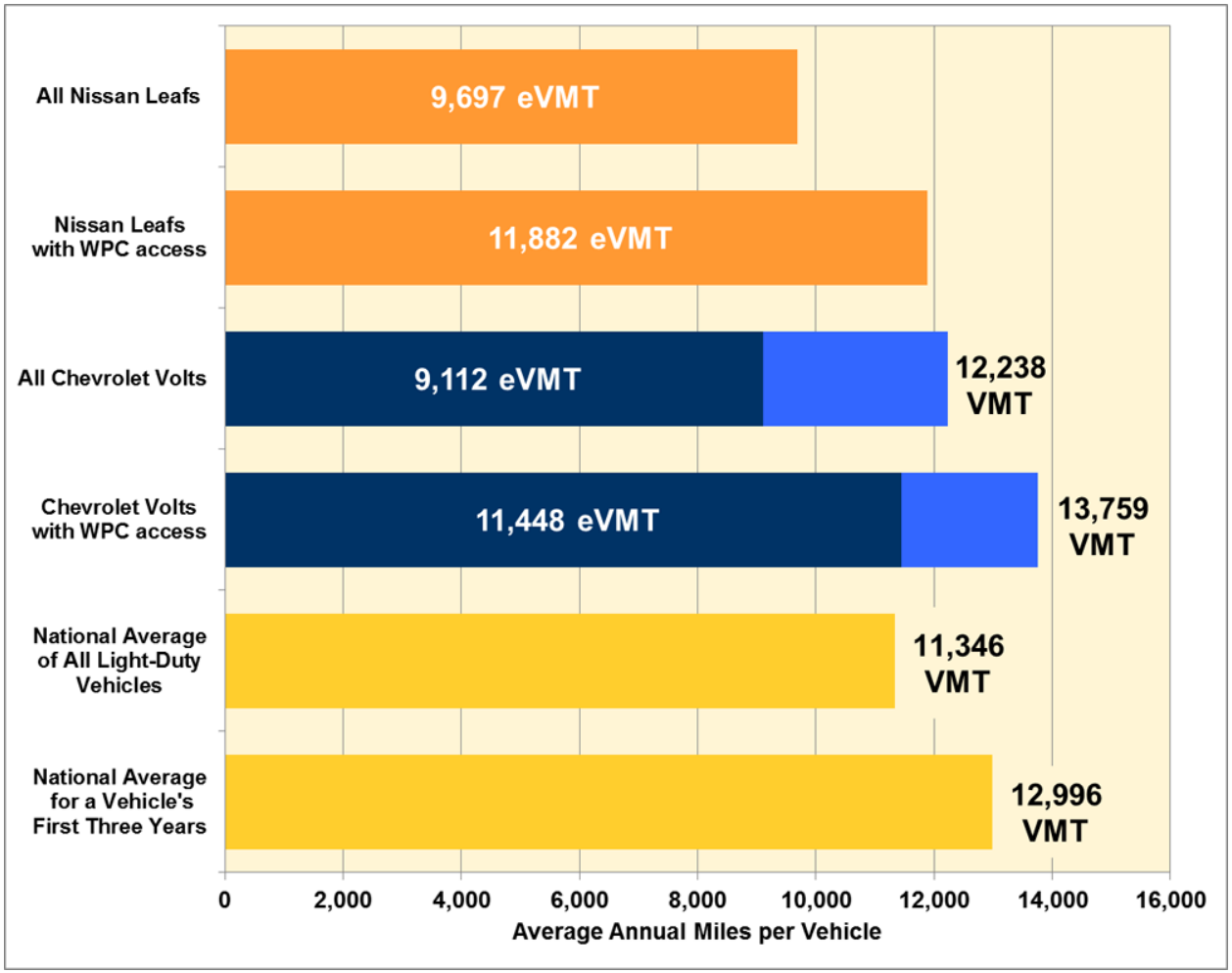


Sample sizes:
Respondents asked about PHEVs overall (n=506); Respondents asked about EVs overall (n=509);
Respondents asked about PHEVs and who were aware of PEV charging stations (n=99);
Respondents asked about EVs and who were aware of PEV charging stations (n=88)

Source: "Consumer Views on Plug-in Electric Vehicles – National Benchmark Report" http://www.nrel.gov/docs/fy16osti/65279.pdf
February 2015 study

driver habits

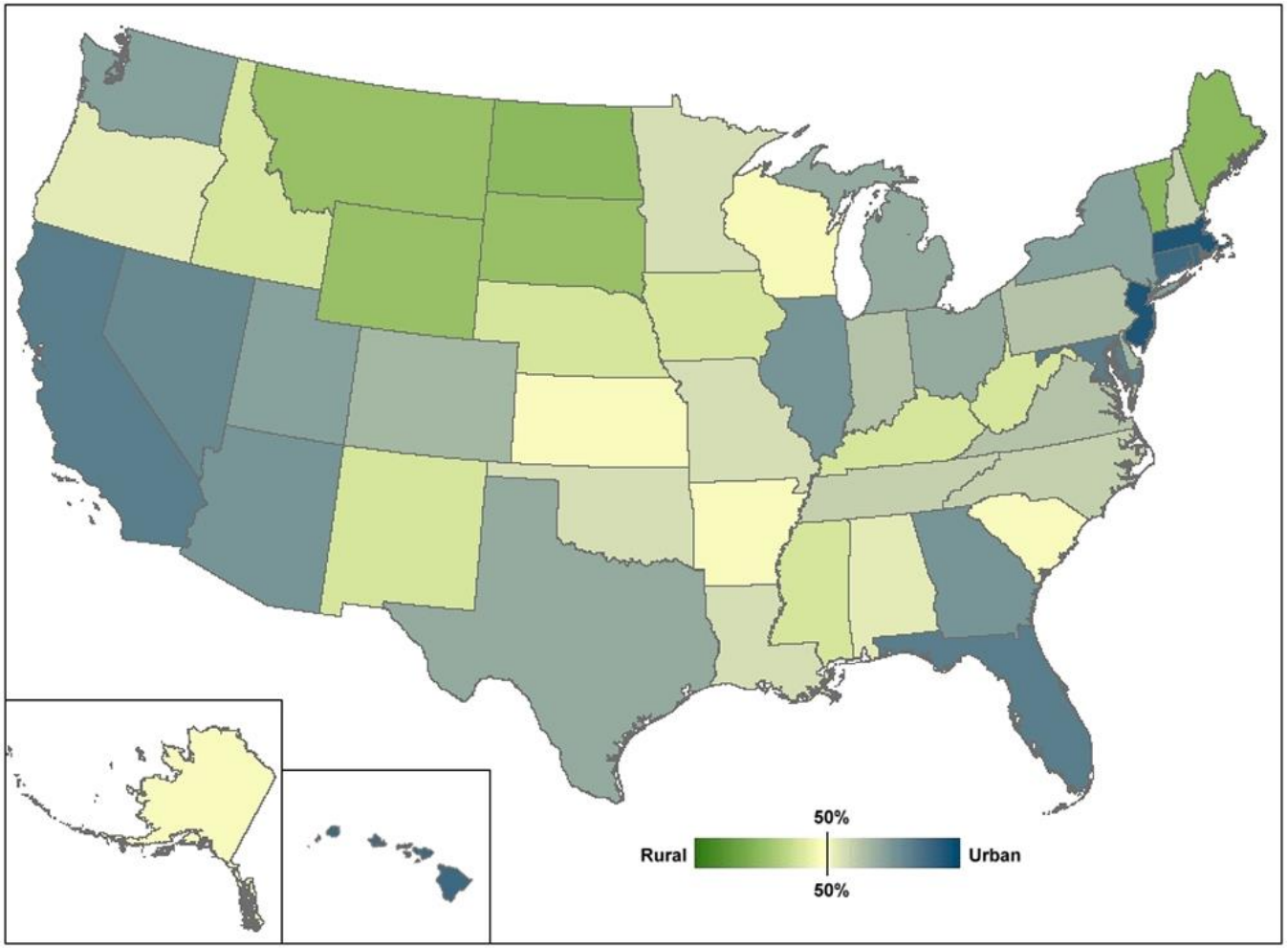
FOTW/INL: Average annual electric miles driven by Leafs and Volts differs by only 5-7%



Source: http://energy.gov/eere/vehicles/fact-911-february-8-2016-workplace-charging-increases-vmt-plug-vehicles-ev-project

travel patterns

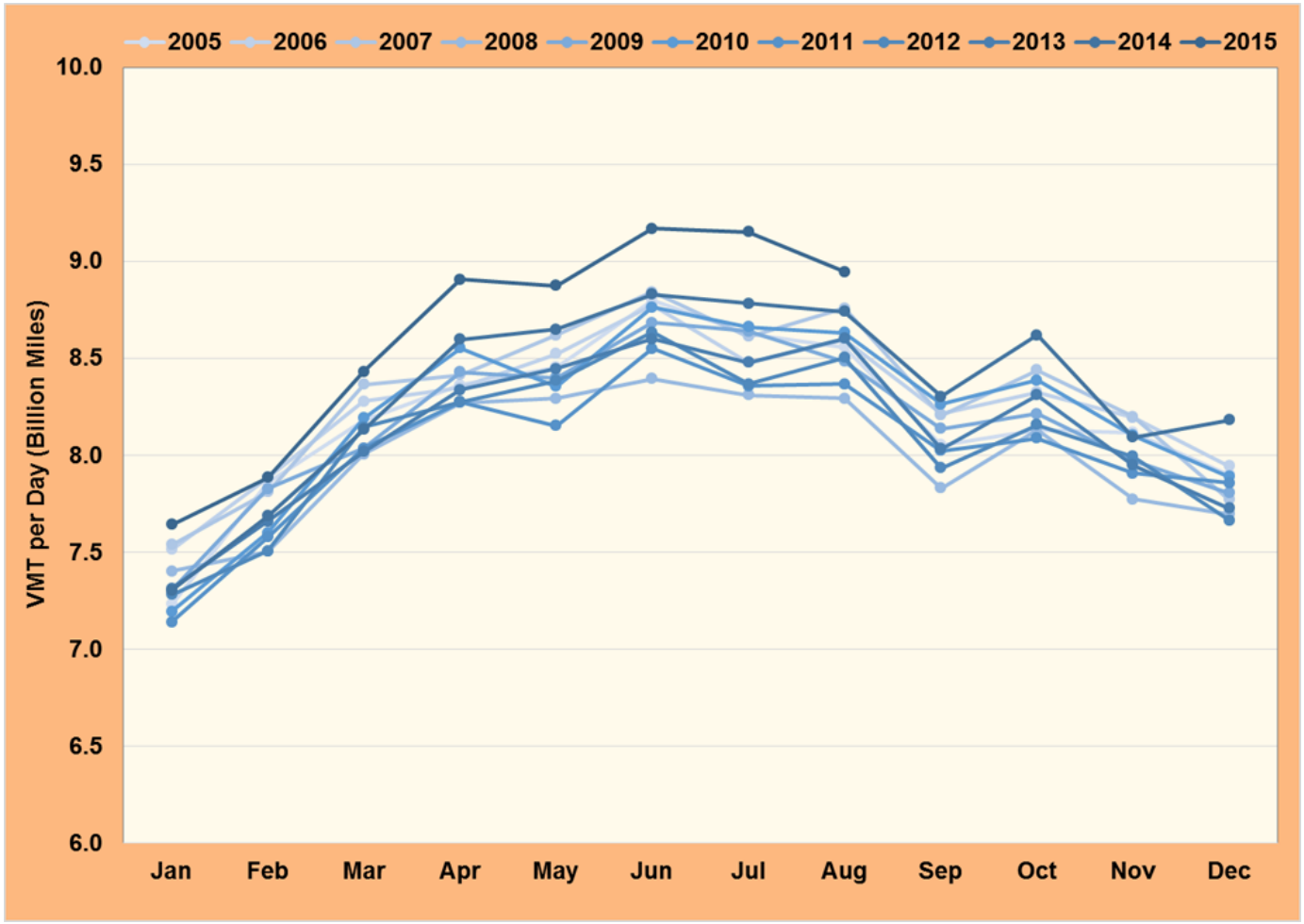
FOTW: Urban/rural driving mix varies—sometimes greatly—by state



Source: http://energy.gov/eere/vehicles/fact-902-december-7-2015-rural-versus-urban-vehicle-miles-travel-state

travel patterns

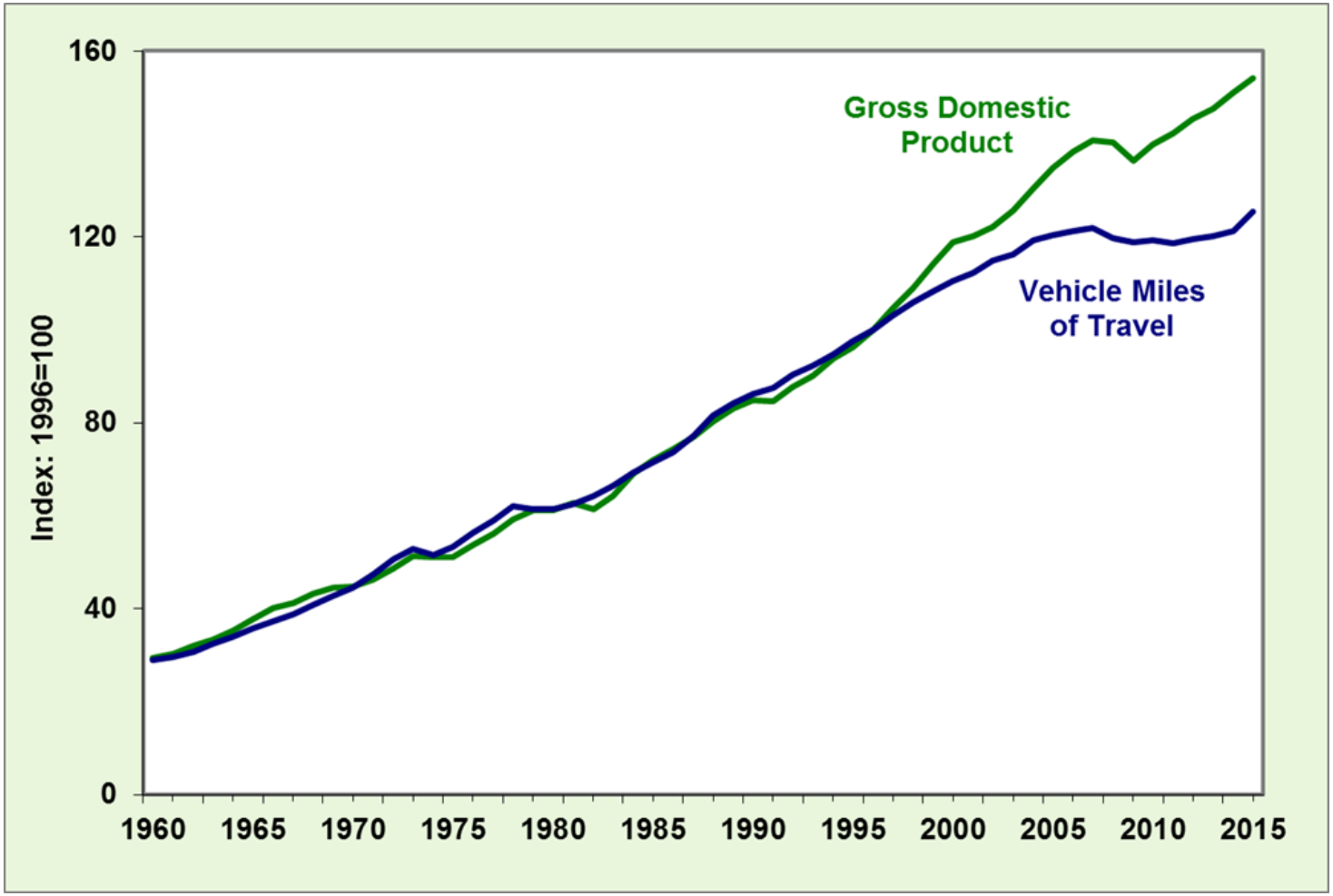
FOTW: Total mileage per-day is increasing year-over-year, with highest travel demand in summer



Source: http://energy.gov/eere/vehicles/fact-903-december-14-2015-vehicle-miles-travel-2015

travel patterns

FOTW: VMT mostly decoupled from GDP since around 2000; both are currently increasing

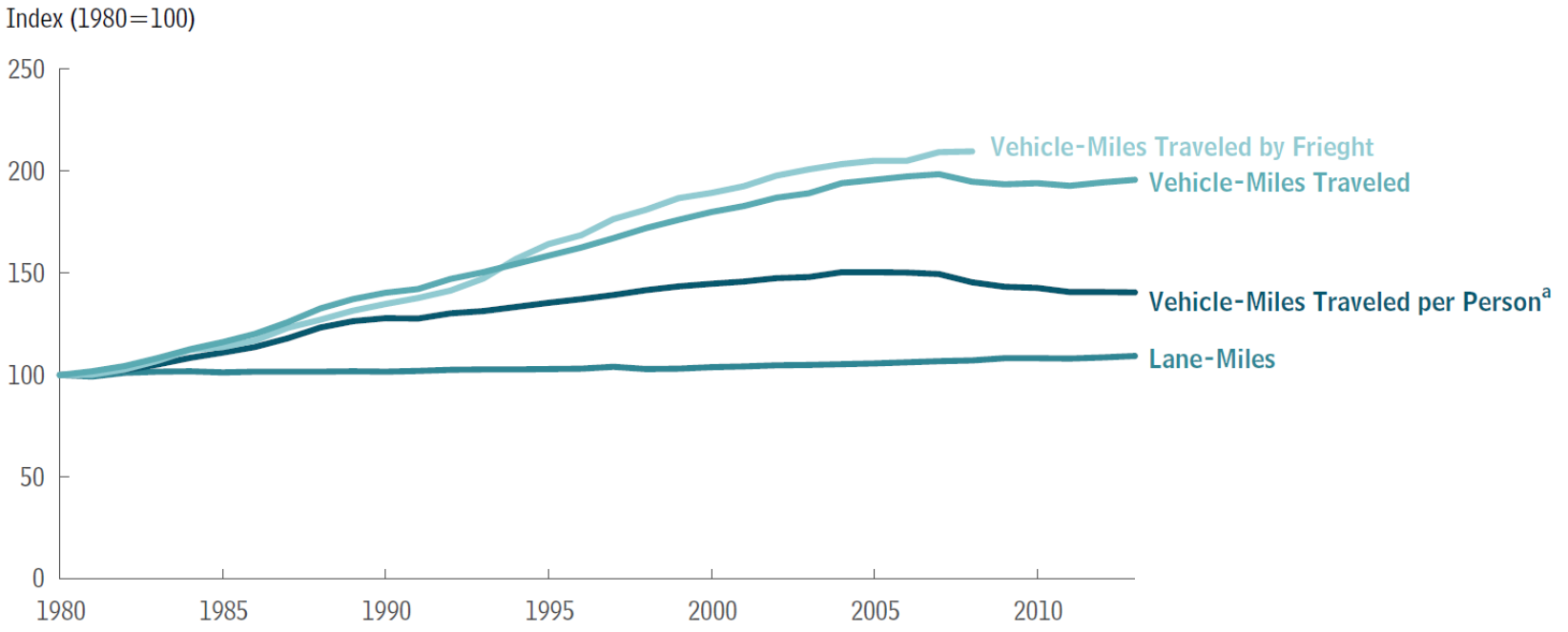


Source: http://energy.gov/eere/vehicles/fact-904-december-21-2015-gross-domestic-product-and-vehicle-travel-both-increased

travel patterns

CBO: VMT increased since 1980, despite the number of lane-miles remaining roughly constant

Changes in Highway Use and Lane-Miles



Source: Congressional Budget Office based on data from the Federal Highway Administration, the Bureau of Transportation Statistics, and the Census Bureau.

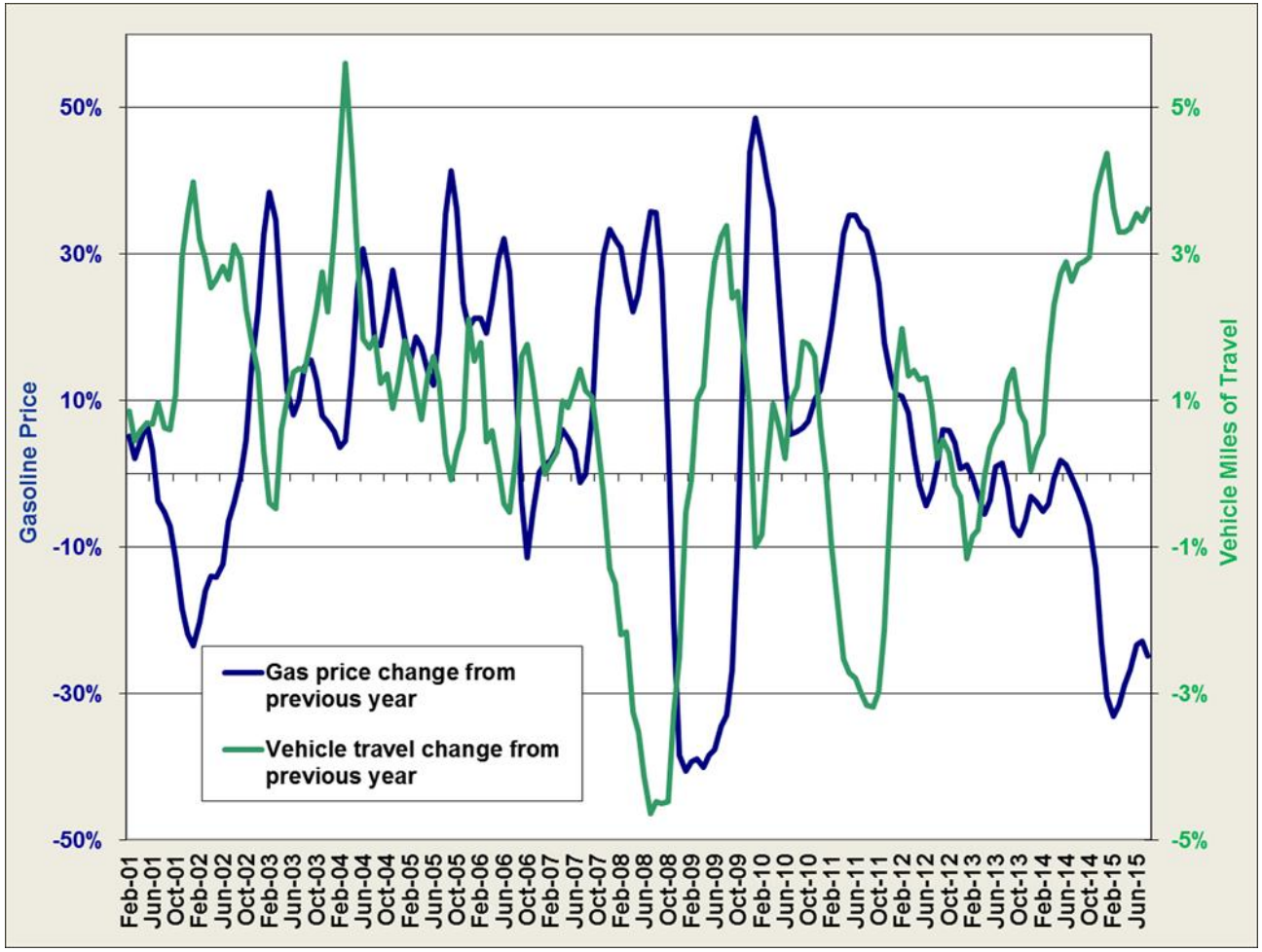
Note: Because of a change in the Federal Highway Administration's methodology, data for freight vehicle-miles traveled after 2008 are not comparable with the information from earlier periods, so they are not separately reported in this figure. Data for vehicle-miles traveled and vehicle-miles traveled per person include both passenger and freight vehicles.

a. The amounts shown are based on the population residing in the United States.

Source: https://www.cbo.gov/publication/50150

driver habits / oil markets

FOTW: VMT and gasoline price typically move in opposition



Source: http://energy.gov/eere/vehicles/fact-906-january-4-2016-vmt-and-price-gasoline-typically-move-opposition

topics

energy markets

automotive markets

technologies studies

environmental studies

consumers/opinion surveys

6 policy studies

qar

outline

6 policy studies

EV business

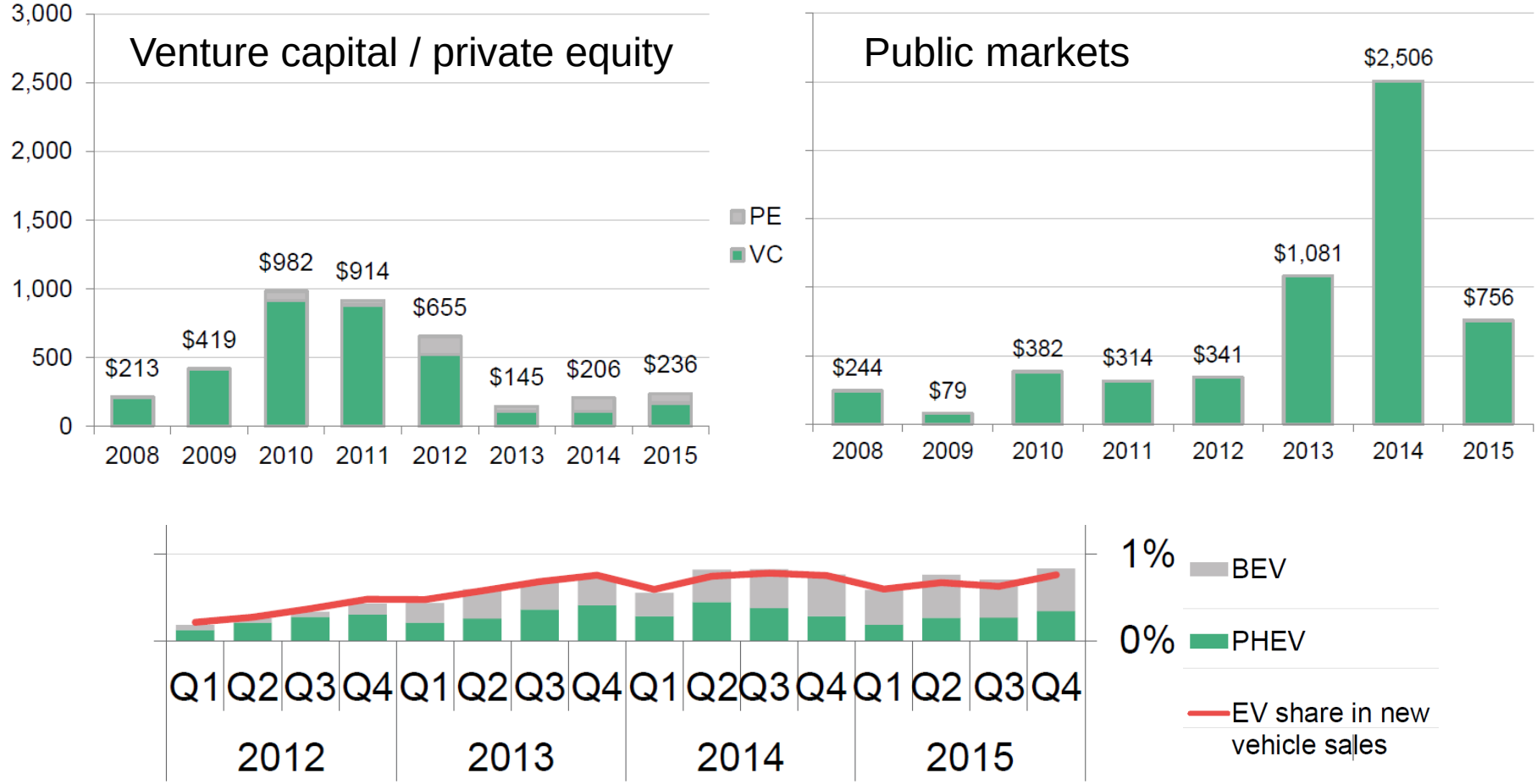
> Bloomberg: Private EV investment happened before EV market grew

drivers licenses

> FHWA: Fewer people are getting driving licenses
> FHWA: Higher percentage of young females than young males with driver's licenses

financial investments

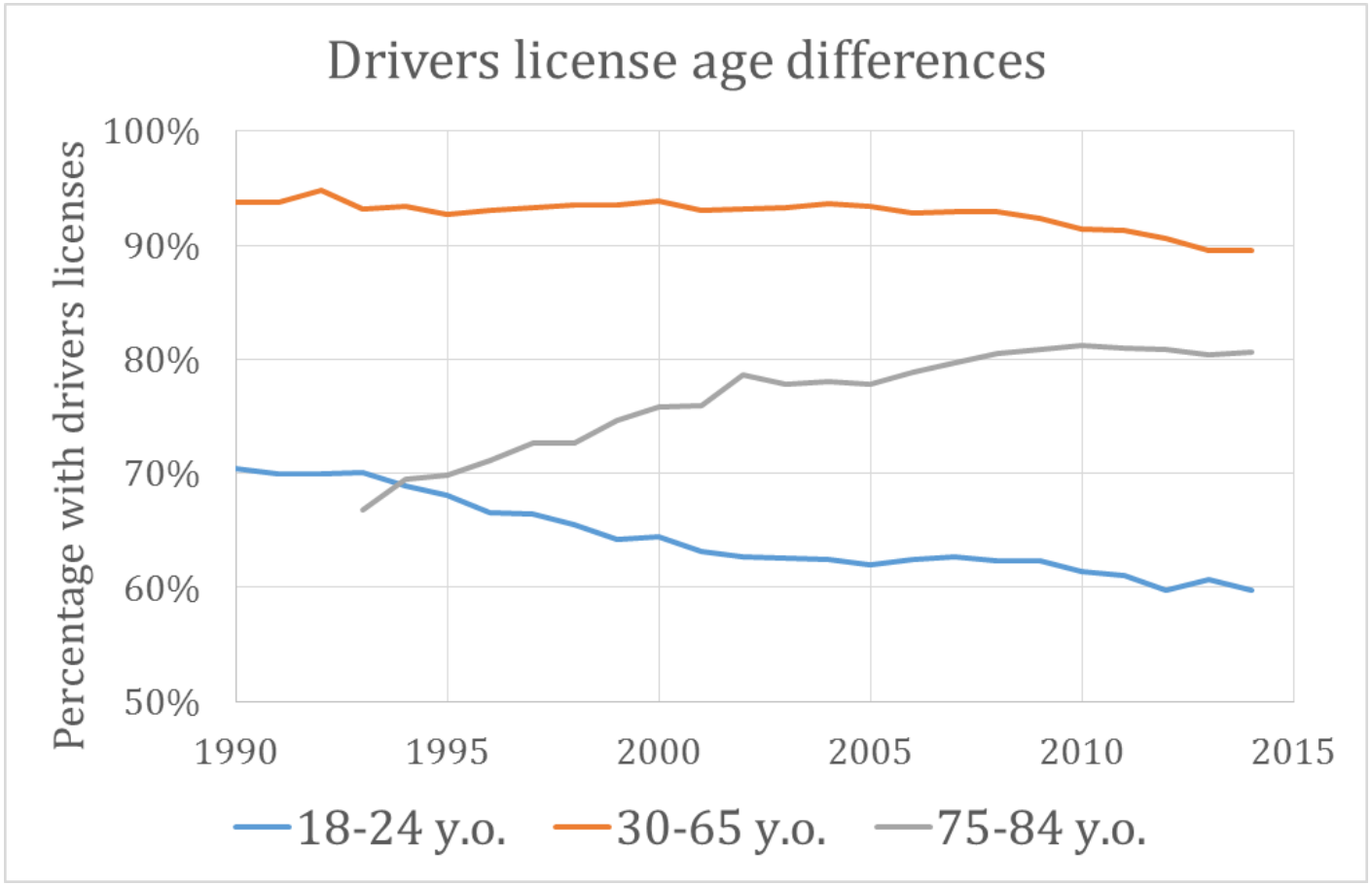
BNEF: Private equity and venture capital investment in EVs preceded public investment and sales



Source: http://www.bcse.org/sustainableenergyfactbook/

driver's licenses

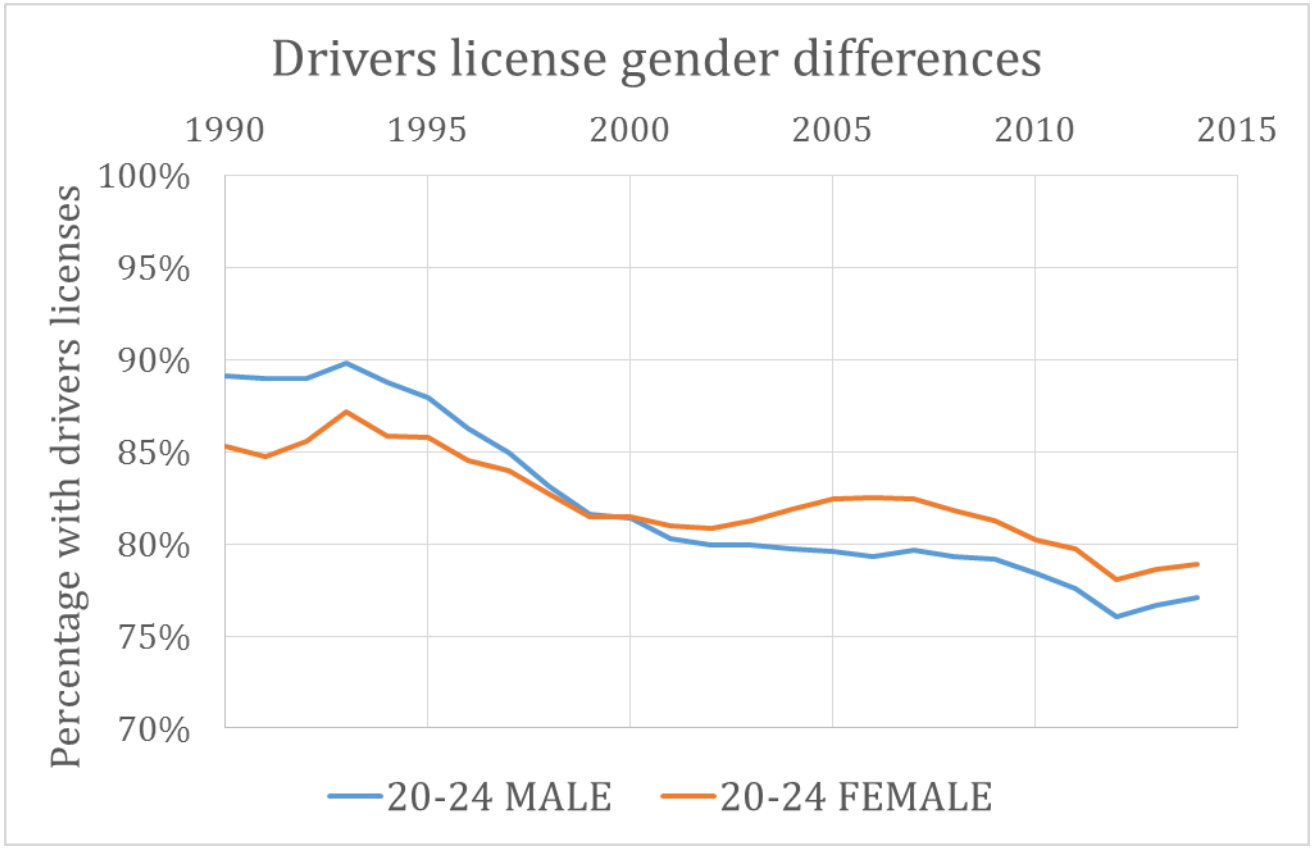
FHWA: Fewer millennials getting drivers licenses (only 60% in 2014); older drivers increasing in number



Source: https://www.fhwa.dot.gov/policyinformation/statistics.cfm and http://www.census.gov/popest/data/index.html

driver's licenses

FHWA: Since 2000, young females are more likely than young males to get a driver's license



Source: https://www.fhwa.dot.gov/policyinformation/statistics.cfm and http://www.census.gov/popest/data/index.html

summary observations

energy Gasoline prices are still low (and got even lower); near-term prices are projected to stay low while inventory is high

automotive U.S. LDV sales—primarily and increasingly trucks—are up to record levels; EV sales stagnant in U.S., but up worldwide

tech/enviro CO_2 emissions declined in 2015; light duty vehicle fuel economy and performance continue to improve; freight traffic projected to increase

opinion/policy EVSE awareness is correlated with positive PEV perception; opinions on CAVs vary; VMT is again increasing

15.4
4Q 2015

qar
summary