



quarterly **a**nalysis review

15.2

2Q 2015

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28 september 2015

topics

1

energy markets

automotive markets

technologies studies

environmental studies

consumer & opinion surveys

policy studies

qar
outline

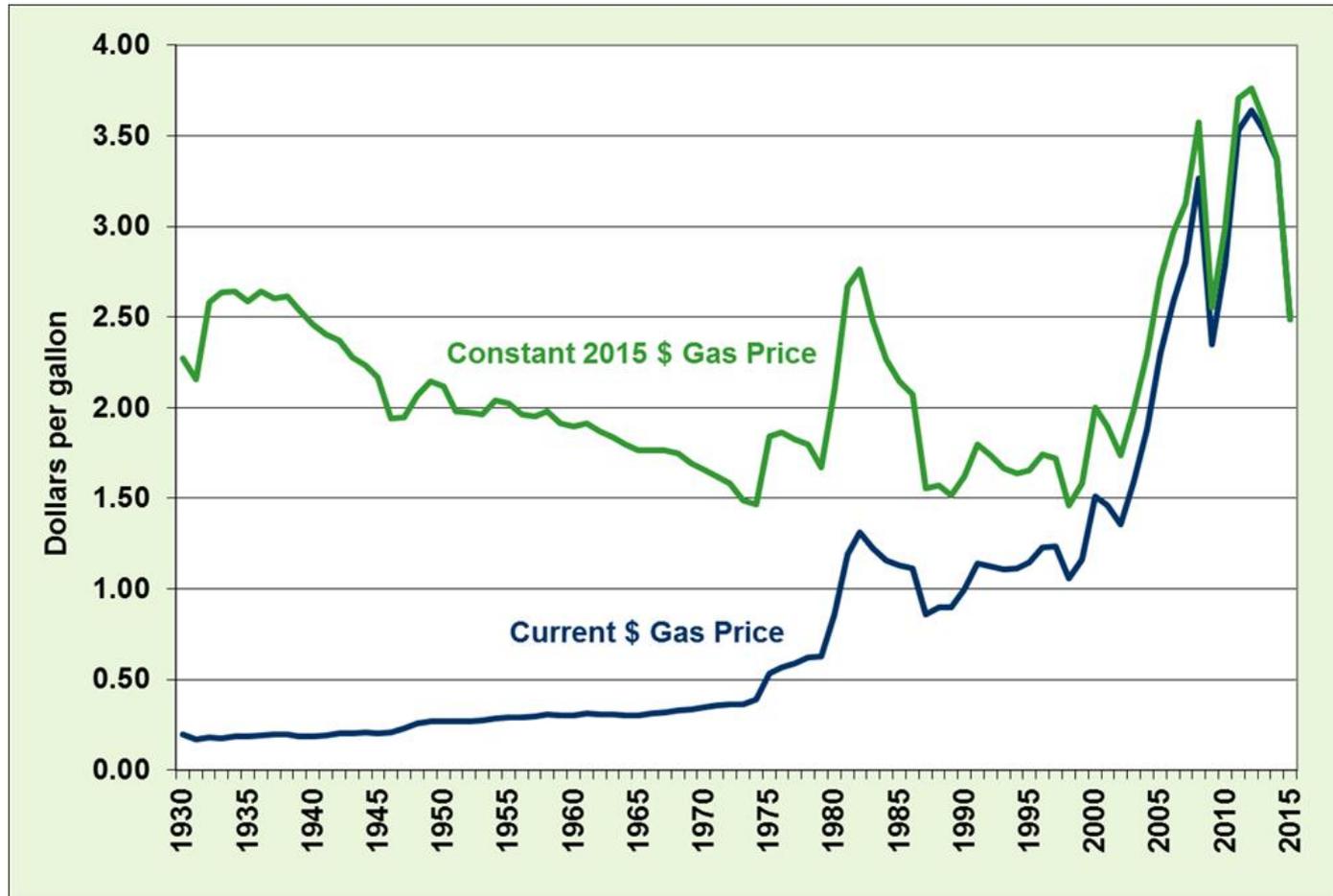
1 energy markets

oil markets

- > FOTW: Gas prices are the lowest in ~10 years, but still above average since 1970 (even in real terms).
- > FOTW: Average diesel fuel price is lower than gasoline for the first time in six years.
- > EIA: California gasoline prices continue to rise further as supply chain is strained.
- > EIA: Labor Day gasoline prices reached their lowest in a decade.
- > EIA: U.S. refineries are running at record-high levels.
- > EIA: U.S. net petroleum product exports continue to increase.
- > EIA: The U.S. comprises 15% of global petroleum supply; OPEC 39%.
- > EIA: Sustained low oil prices could reduce exploration and production investment.
- > EIA: U.S. crude oil and liquid fuels production is projected to drop in 2016.

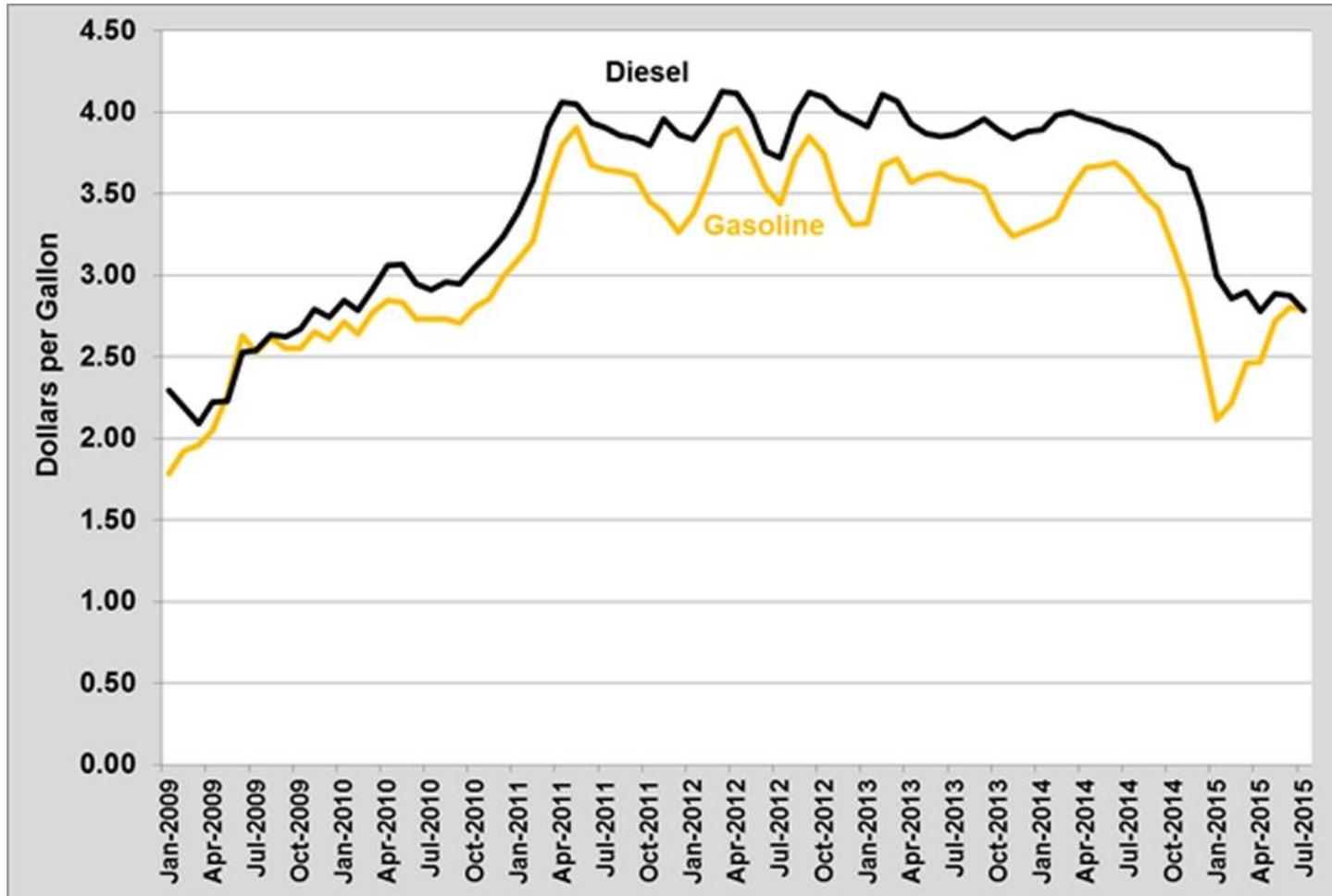
oil markets

FOTW: Gas prices are the lowest in ~10 years, but still above average since 1970 (even in real terms).



oil markets

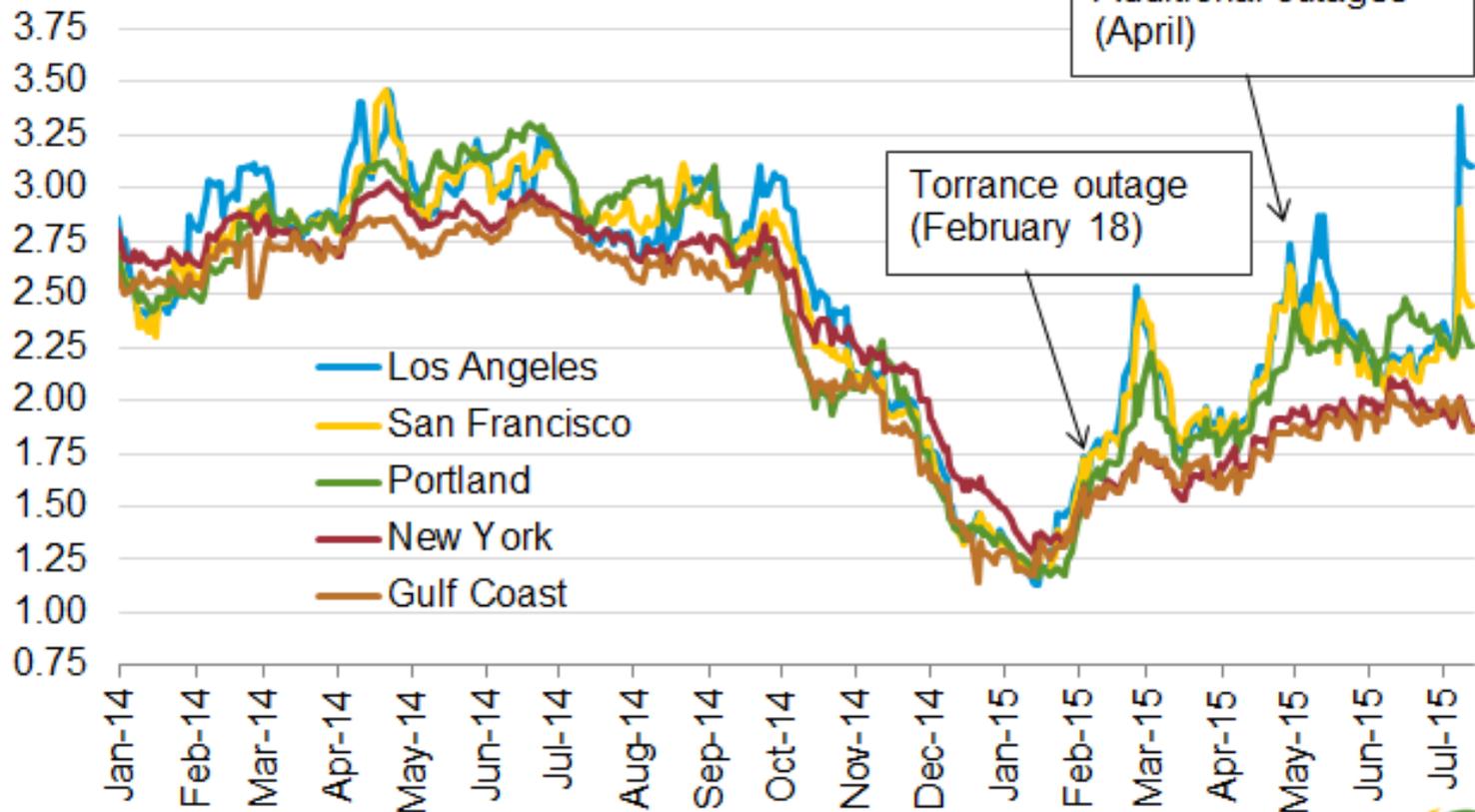
FOTW: Average diesel fuel price is lower than gasoline for the first time in six years.



oil markets

EIA: California gasoline prices continue to rise further as supply chain is strained.

Figure 1. Conventional gasoline spot prices dollars per gallon



Source: U.S. Energy Information Administration, based on Bloomberg.



oil markets

EIA: Labor Day gasoline prices reached their lowest in a decade.

Average U.S. regular retail gasoline price (weekly, 2004-15)

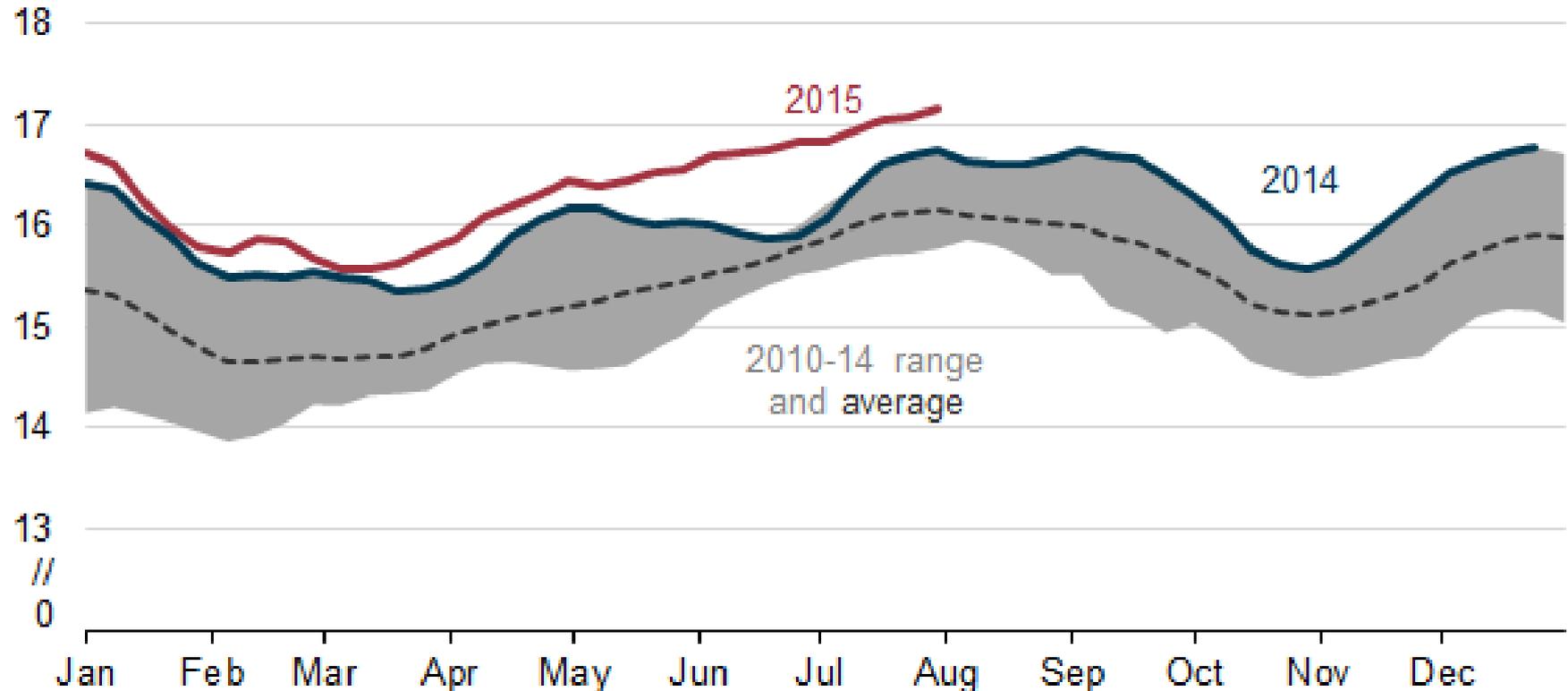
dollars per gallon



oil markets

EIA: U.S. refineries are running at record-high levels.

U.S. gross refinery inputs, rolling four-week average
million barrels per day



oil markets

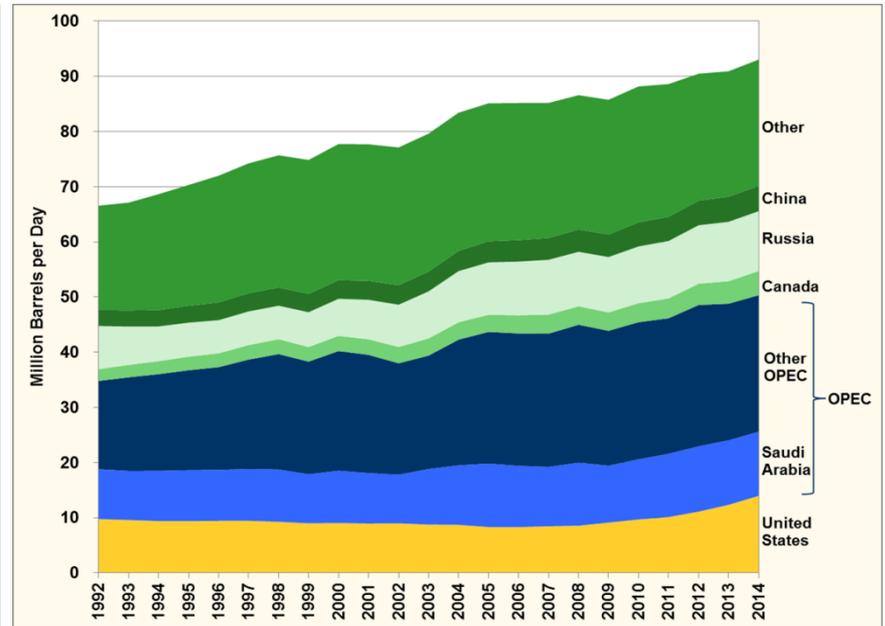
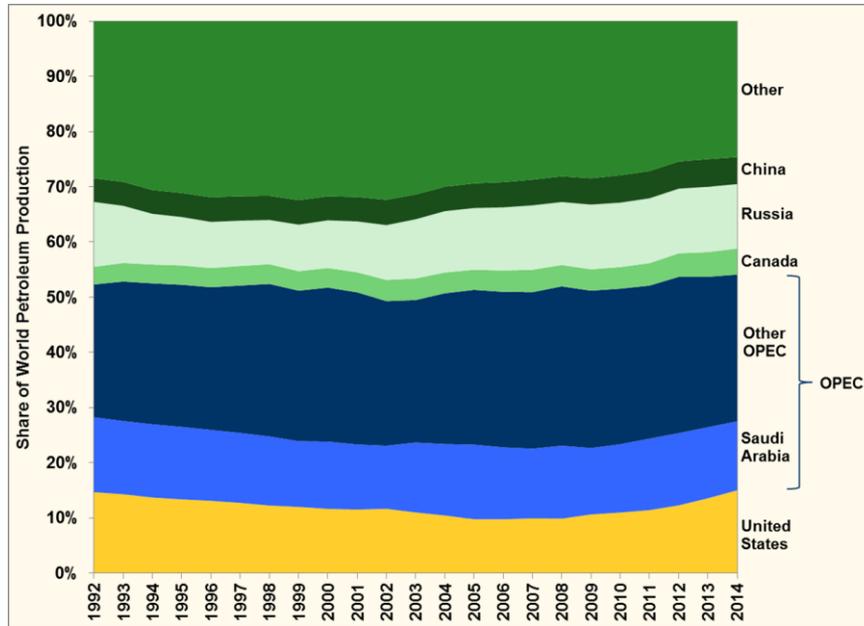
EIA: U.S. net petroleum product exports continue to increase.

U.S. net petroleum product exports (January 2006-April 2015)
thousand barrels per day



oil markets

FOTW: The U.S. comprises 15% of global petroleum supply; OPEC 39%.



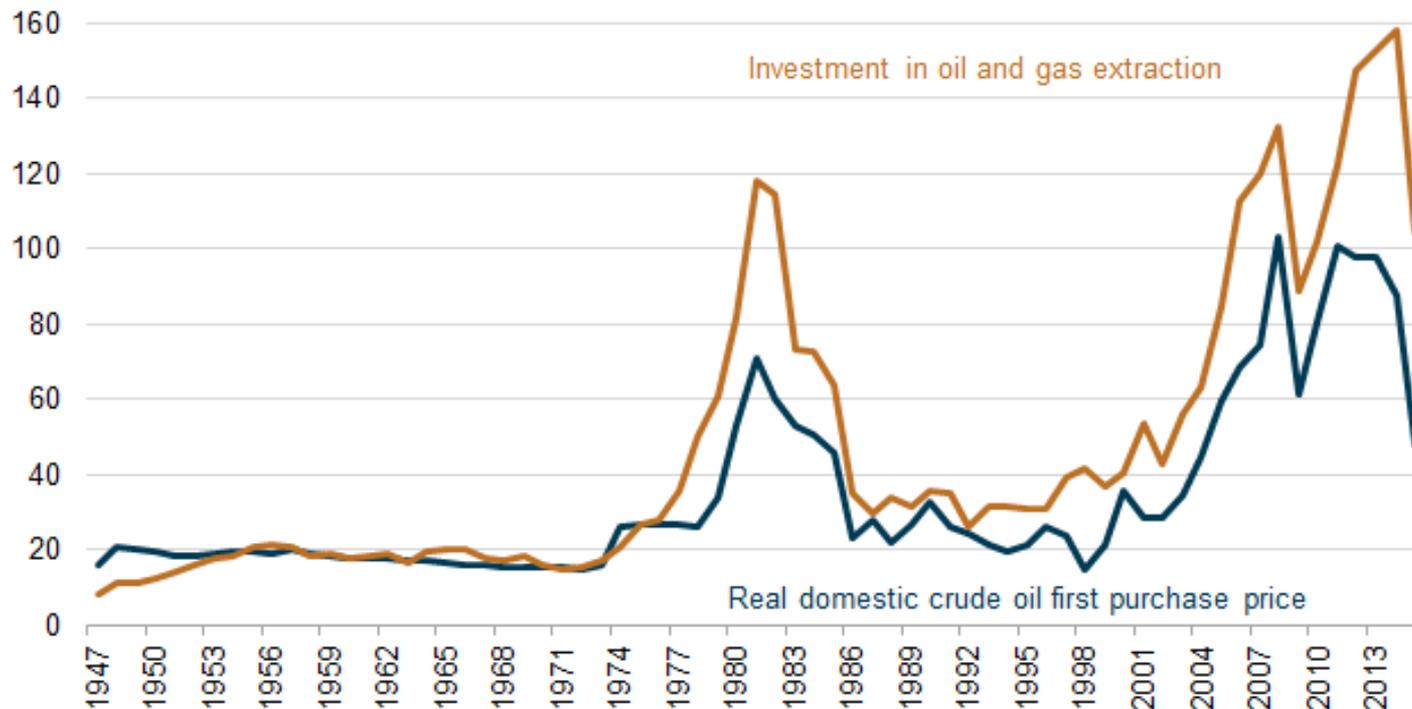
- U.S. increased petroleum production, but accounted for only 15% of World's production in 2014 – the same percentage as in 1992.
- Total petroleum produced world-wide grew from 66.6 mmbd in 1992 to 93.0 mmbd in 2014.
- Production shares by country have changed little over the same time period.
- OPEC accounted for 38% of production in 1992 and 39% in 2014.

oil markets

EIA: Sustained low oil prices could reduce exploration and production investment.

Figure 1: Investment and oil prices

Investment in billion 2014\$, oil in 2014 \$/b

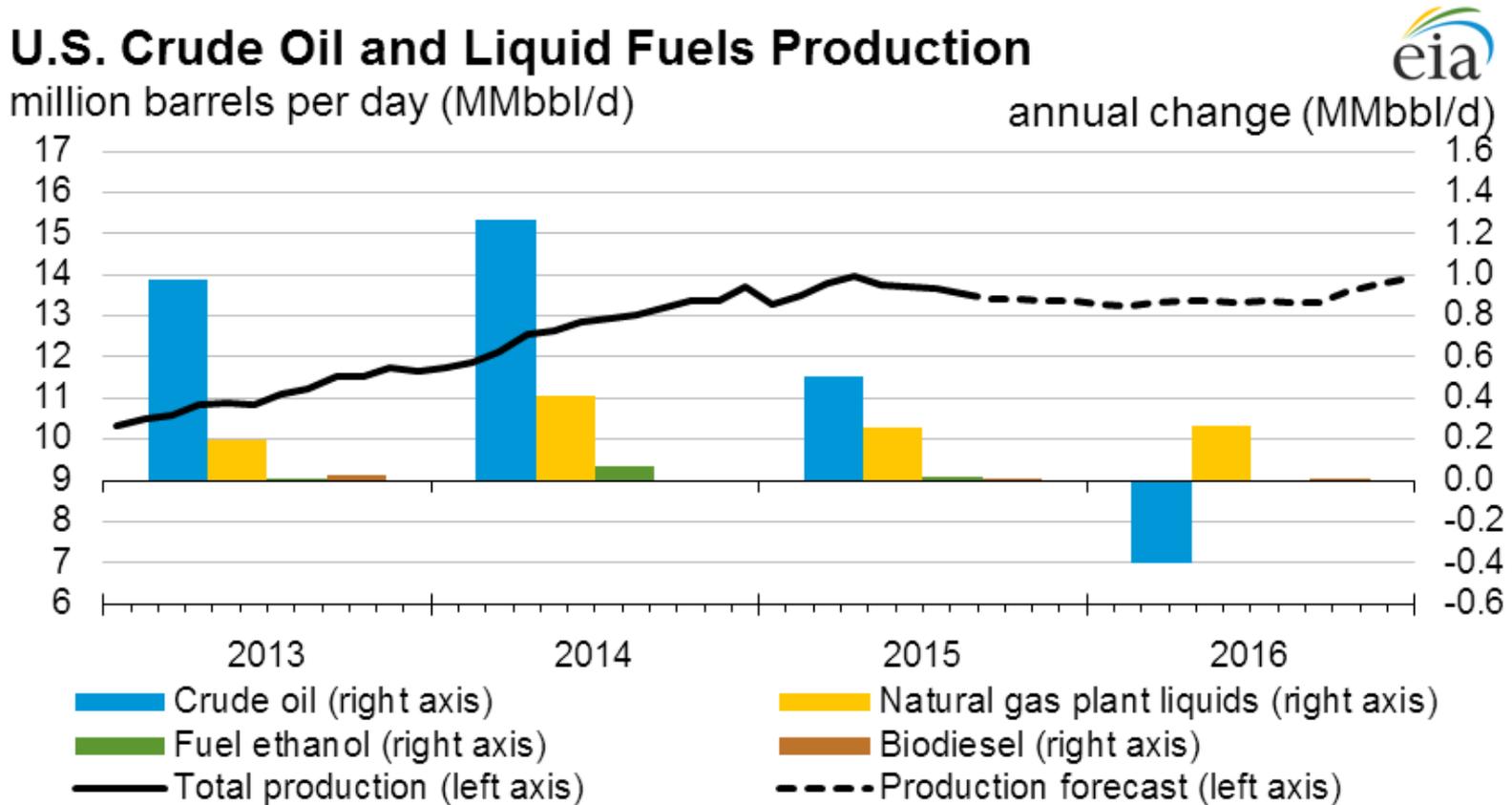


Source: U.S. Bureau of Economic Analysis, U.S. Energy Information Administration

Note: 2015 data is average of first two quarters

oil markets

EIA: U.S. crude oil and liquid fuels production is projected to drop in 2016.



Source: Short-Term Energy Outlook, September 2015.

topics

energy markets

2 automotive markets

technologies studies

environmental studies

consumers/opinion surveys

policy studies

qar
outline

2 automotive markets

PEV market

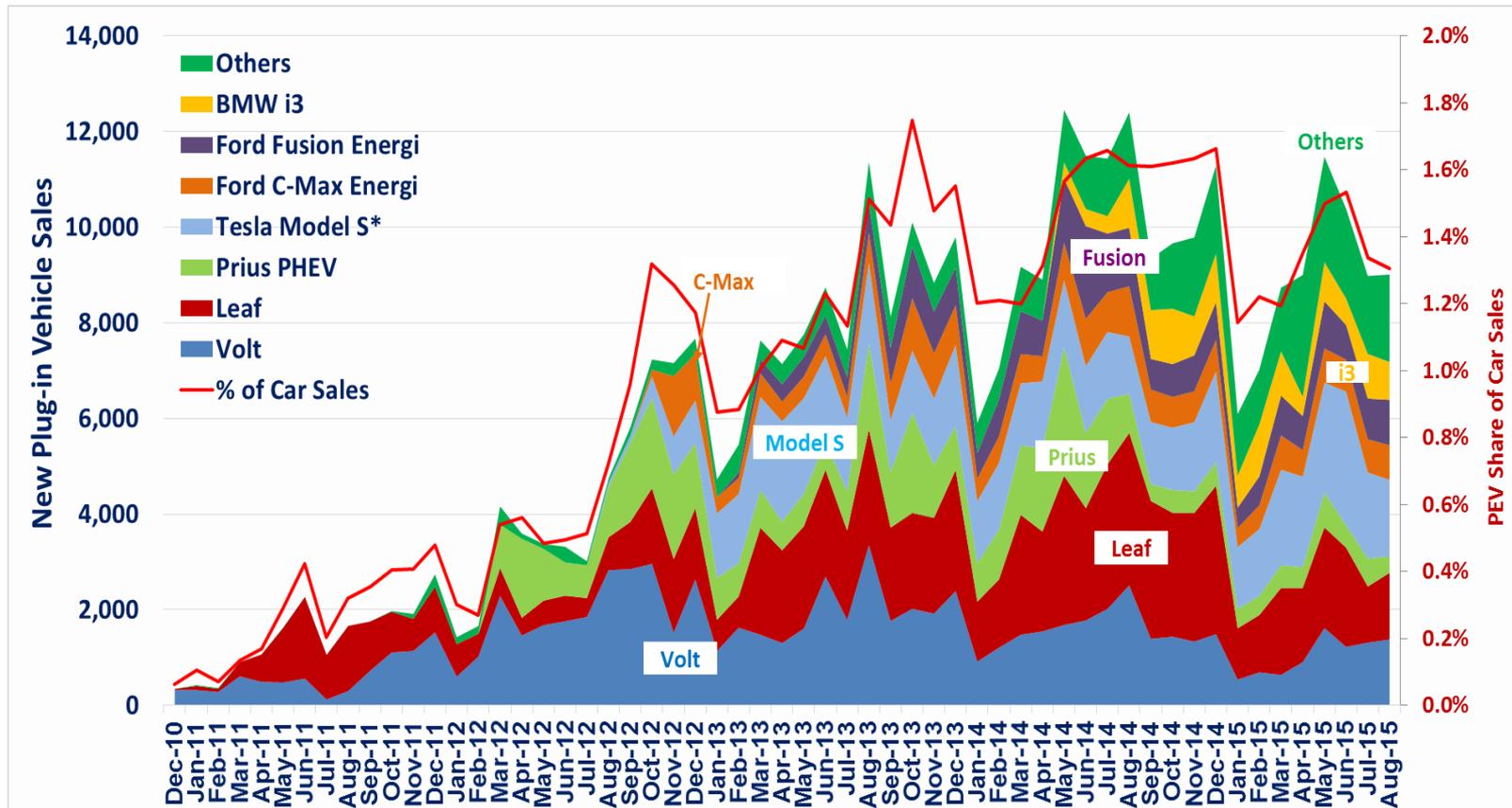
- > ANL: PEV monthly sales volumes have stagnated (though continue to change by make/model).
- > ANL: Overall PEV sales are pressured downward by shift away from cars (to light trucks).
- > ANL: PEV market penetration—both overall, and PHEV-to-BEV ratio—differs by region.
- > FOTW: The one-millionth PEV globally was sold in September 2015 (500,000 mark was in July 2014).

LDV market

- > FOTW: Leasing new light-vehicle (vs. purchase) is more common in the northeast and mid-west.
- > NYTimes: Diesel VW light vehicles were sold primarily in the Pacific Northwest and New England (2009-2015).

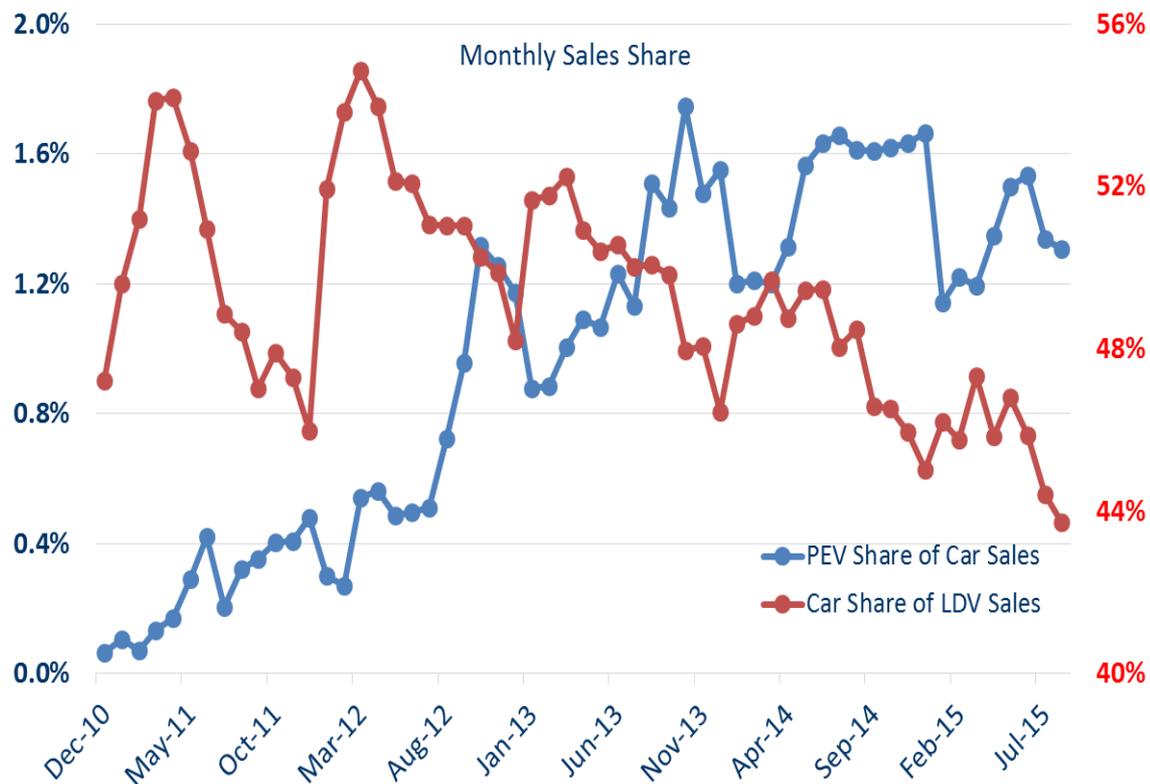
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PEV market

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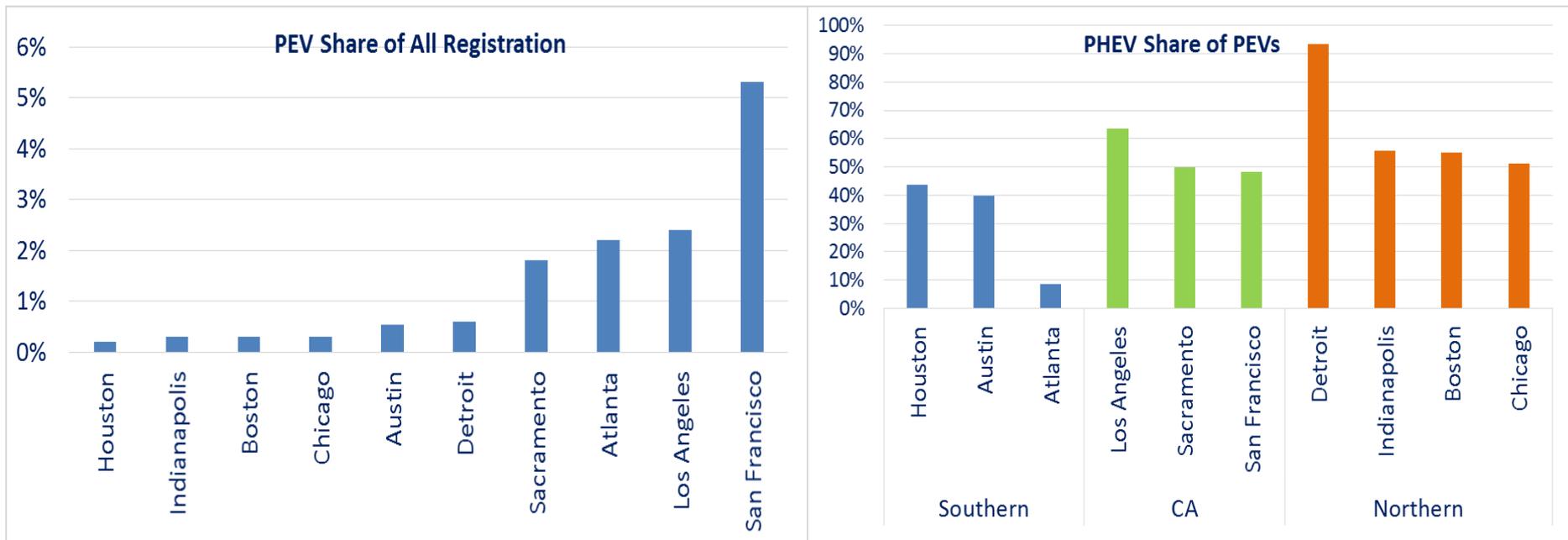


Overall PEV sales are mostly flat in 2015 largely because share of car sales is down. Within cars PEV shares have leveled, not fallen.

On average, the luxury/performance Tesla accounts for 40% of BEV sales

PEV market

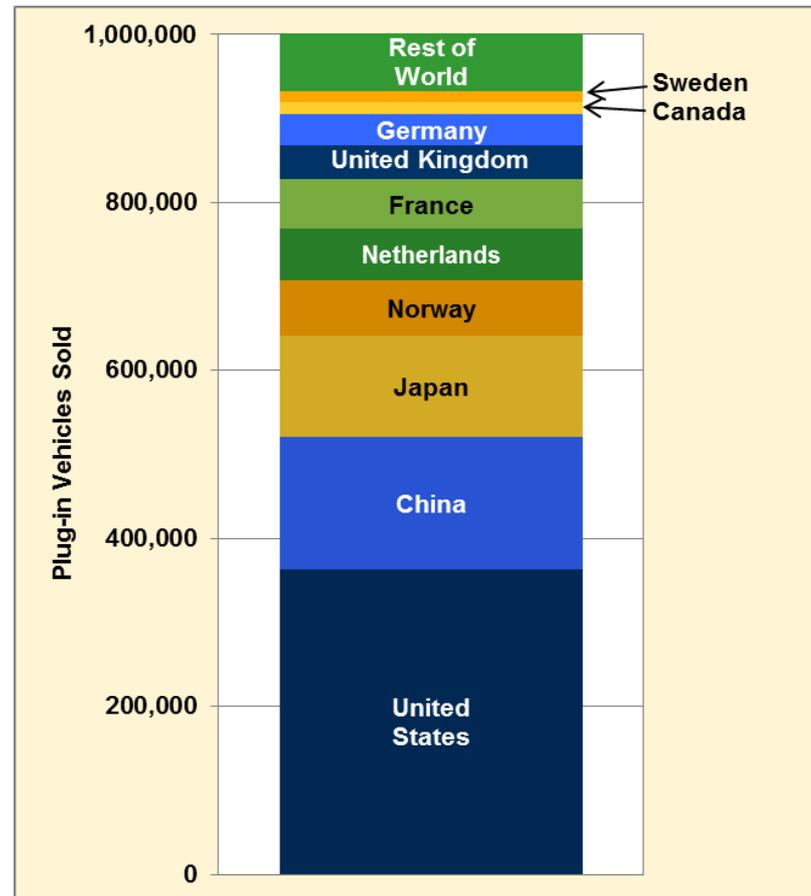
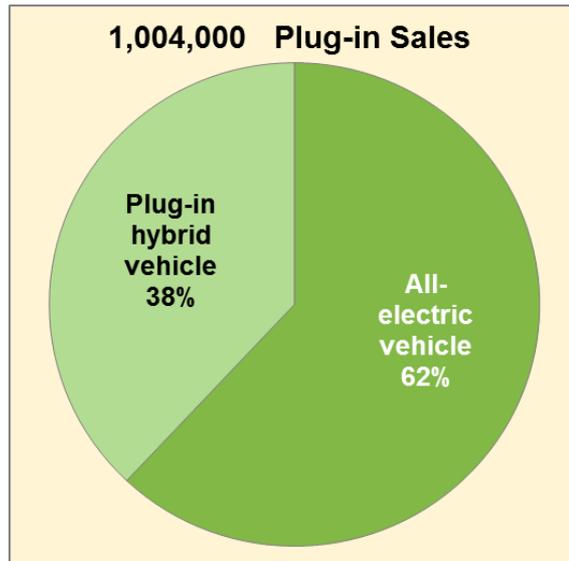
ANL: PEV market penetration—both overall, and PHEV-to-BEV ratio—differs by region.



- The Pacific coast (particularly San Francisco) has the largest E-drive share
- California metros have the highest E-drive and PEV shares of total registrations.
- Atlanta has the lowest PHEV share by far (due to state incentive)
- Detroit the highest

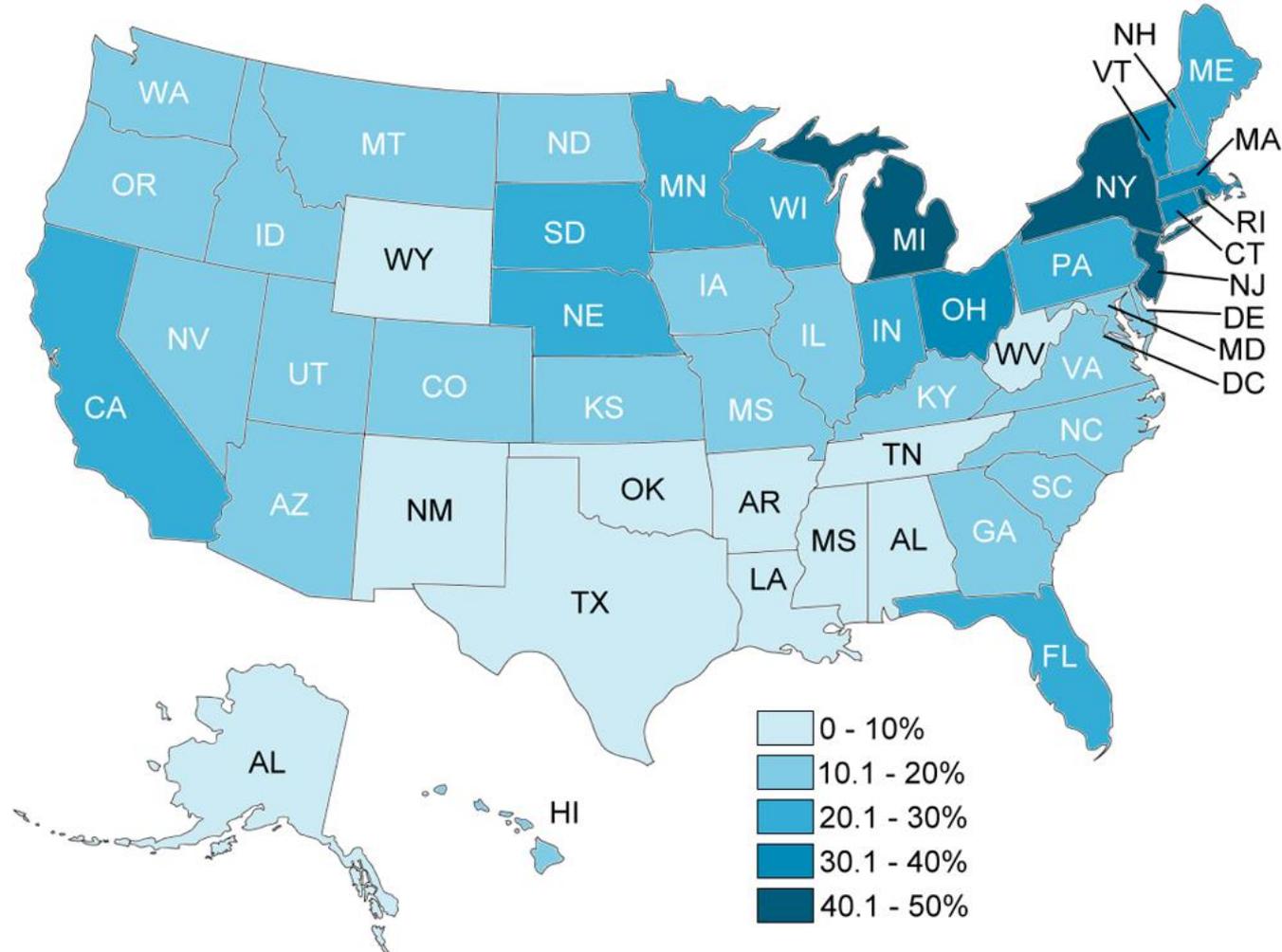
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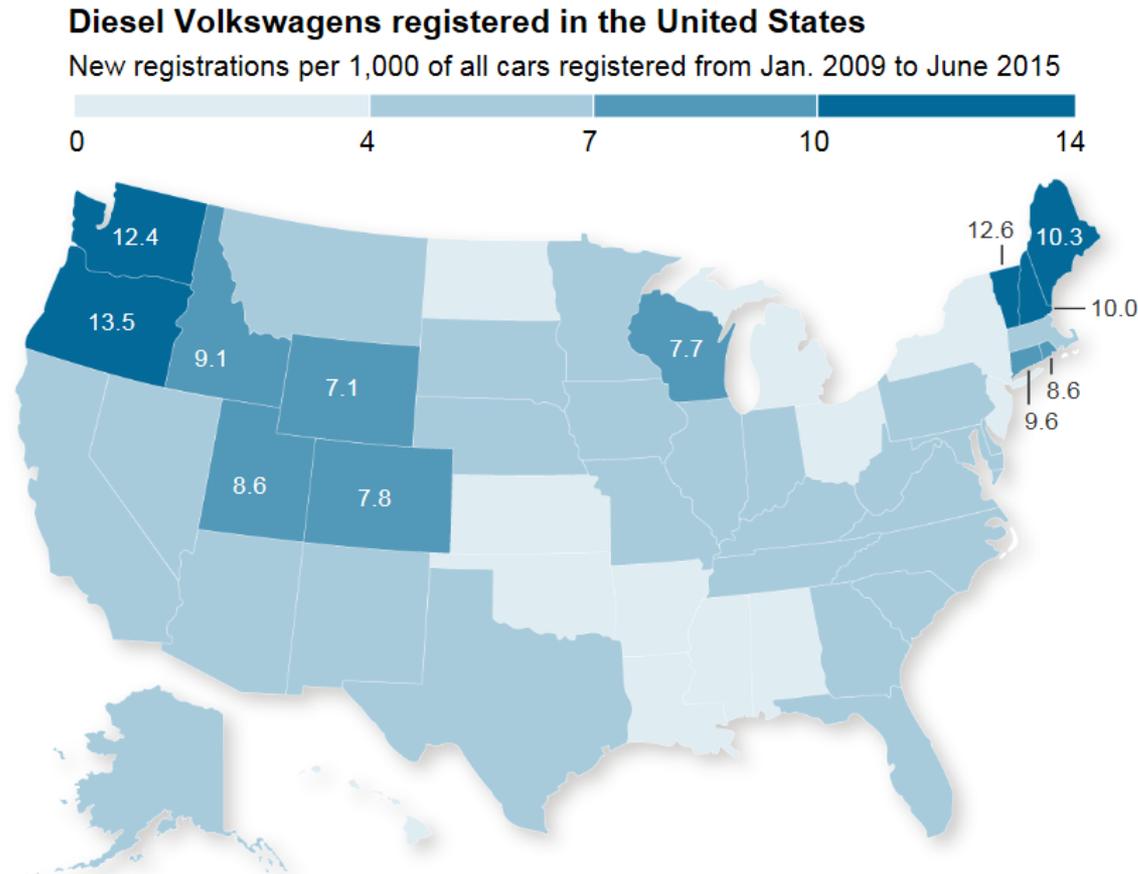
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FOTW: Leasing new light-vehicle (vs. purchase) is more common in the northeast and mid-west.



LDV market

NYTimes: Diesel VW light vehicles were sold primarily in the Pacific Northwest and New England (2009-2015).



Sources: Euromonitor International; Reuters; Kelley Blue Book

topics

energy markets

automotive markets

3 technologies studies

environmental studies

consumers/opinion surveys

policy studies

qar
outline

3 technologies studies

powertrain efficiency

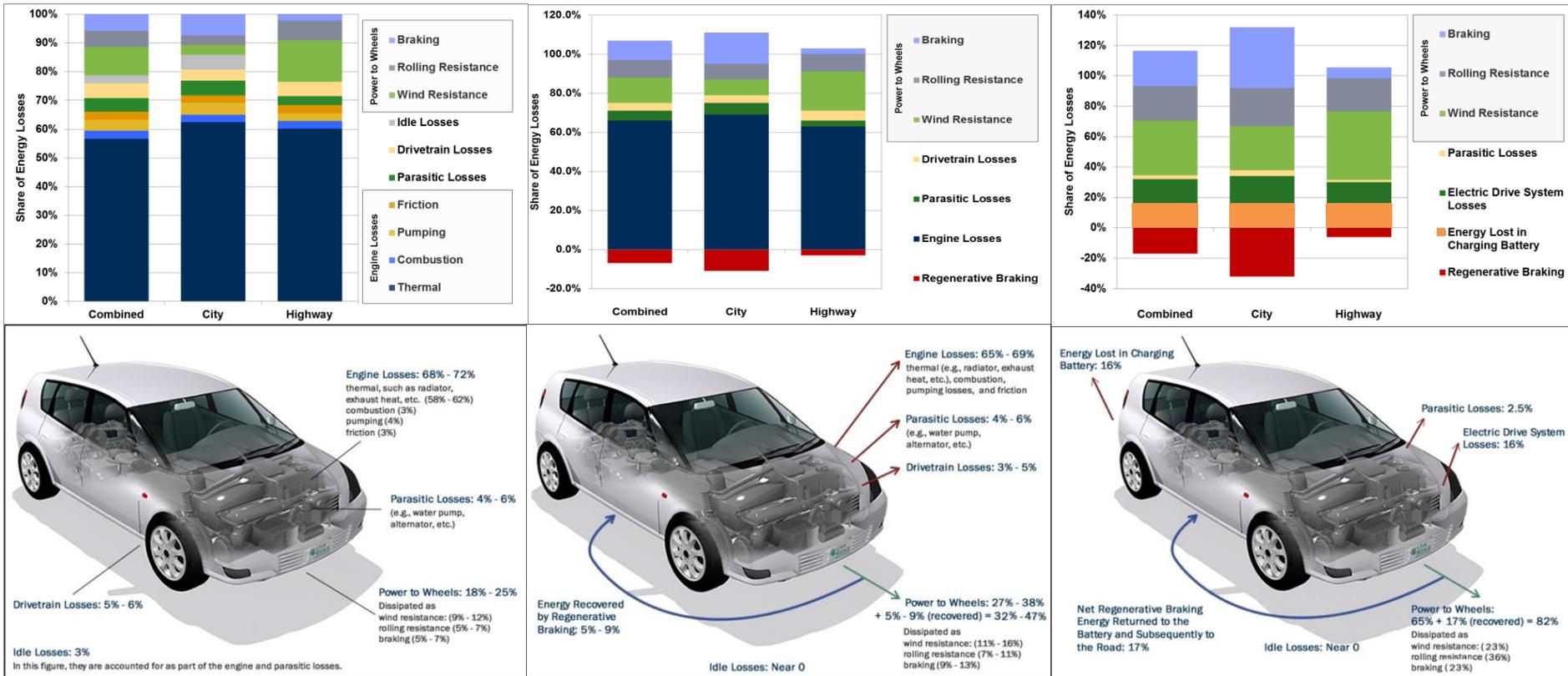
- > FOTW: Energy flow through conventional, hybrid, and electric vehicle powertrains differs.
- > FOTW: Conventional powertrain efficiency has improved >10% over 8 years.
- > FOTW: Hybrid powertrain efficiency improvement vs. conventional counterparts varies (from ~25–75%).

intelligent transportation

- > TAMU: Traffic increase nationwide this decade, reasonably high traffic mid-day (non-peak).

powertrain efficiency

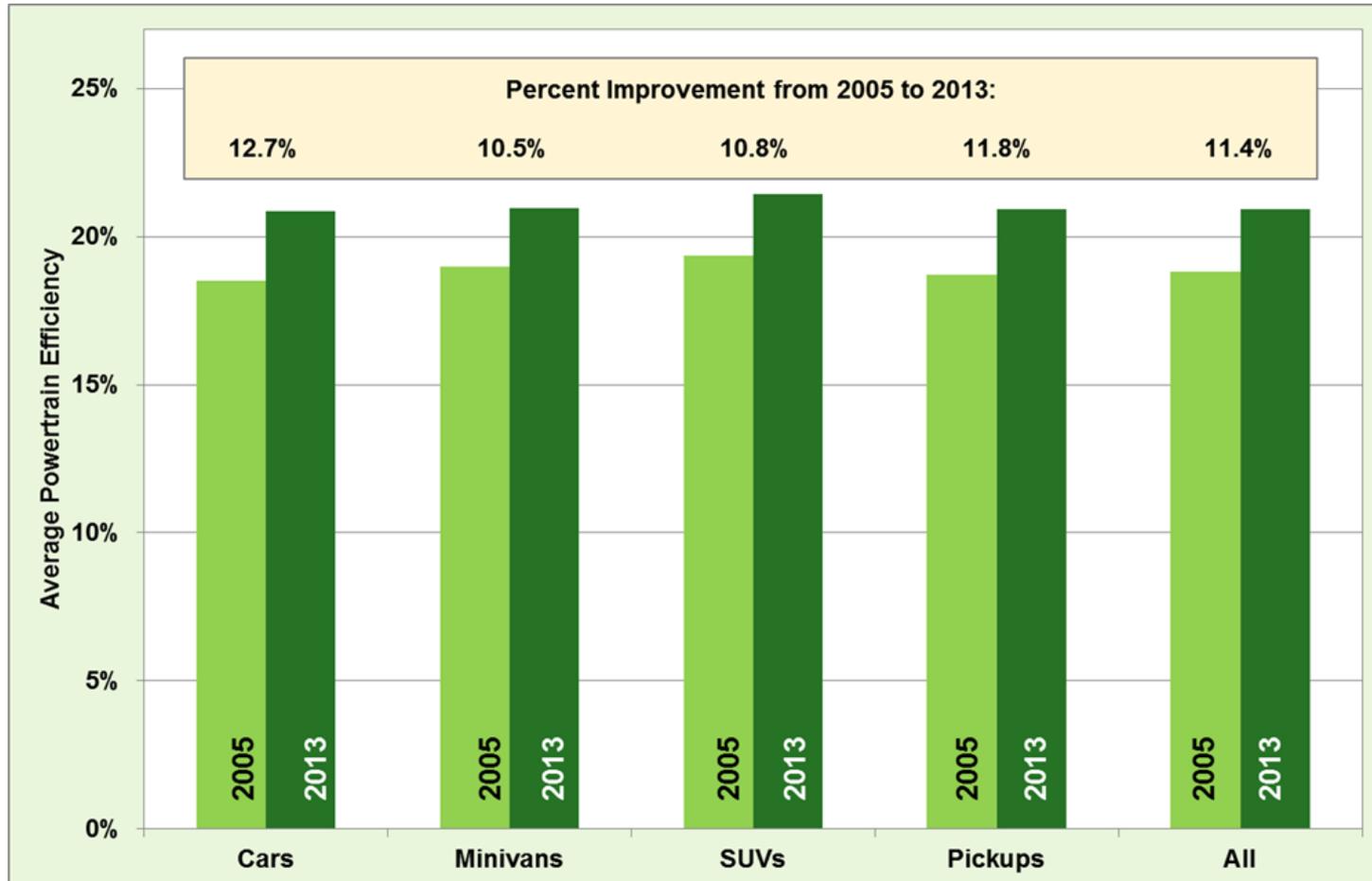
FOTW: Energy flow through conventional, hybrid, and electric vehicle powertrains differs.



Source: <http://energy.gov/eere/vehicles/fact-880-july-6-2015-conventional-vehicle-energy-use-where-does-energy-go;>
<http://energy.gov/eere/vehicles/fact-882-july-20-2015-hybrid-vehicle-energy-use-where-does-energy-go;>
<http://energy.gov/eere/vehicles/fact-884-august-3-2015-all-electric-vehicle-where-does-energy-go>

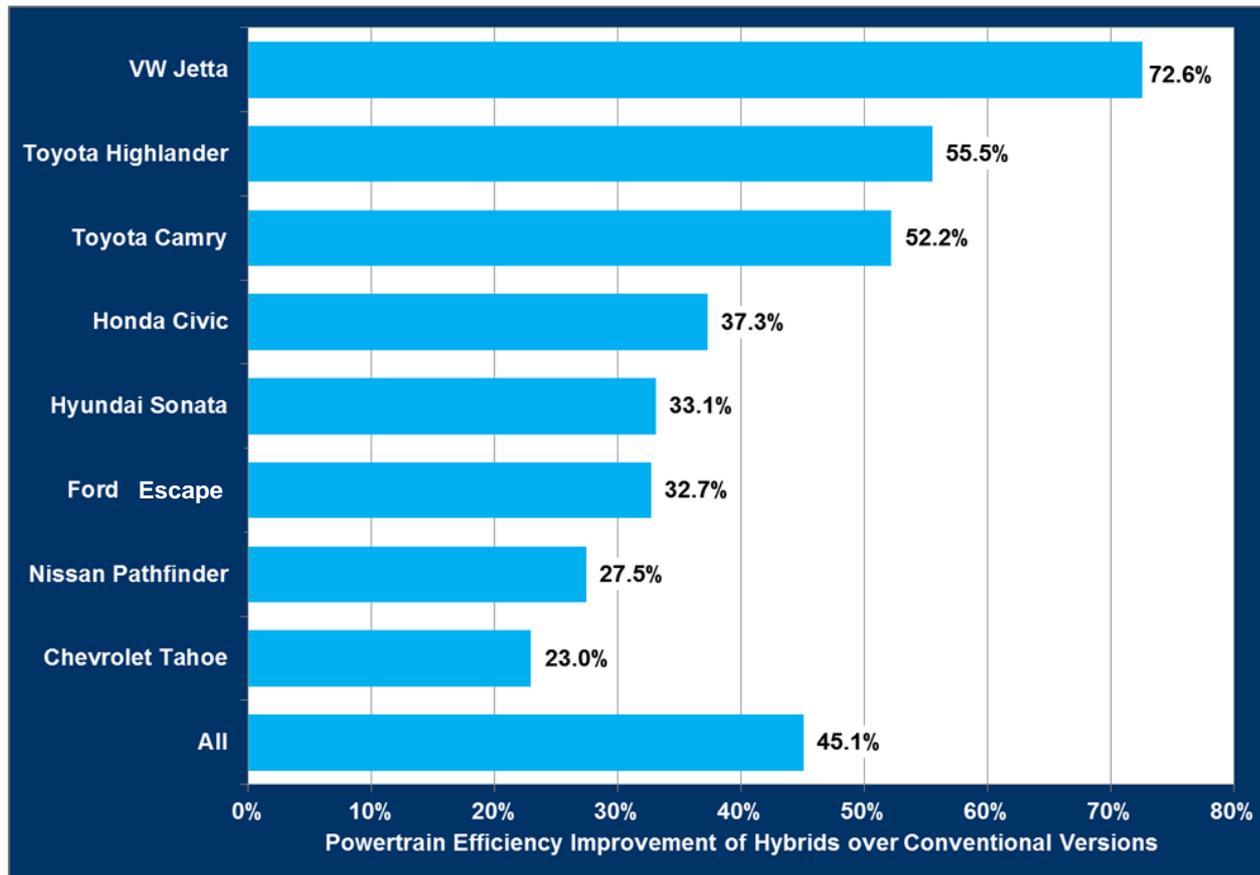
powertrain efficiency

FOTW: Conventional powertrain efficiency has improved >10% over 8 years.



powertrain efficiency

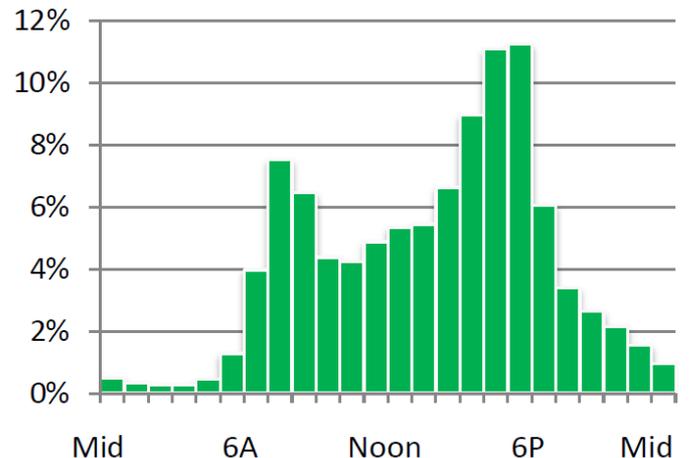
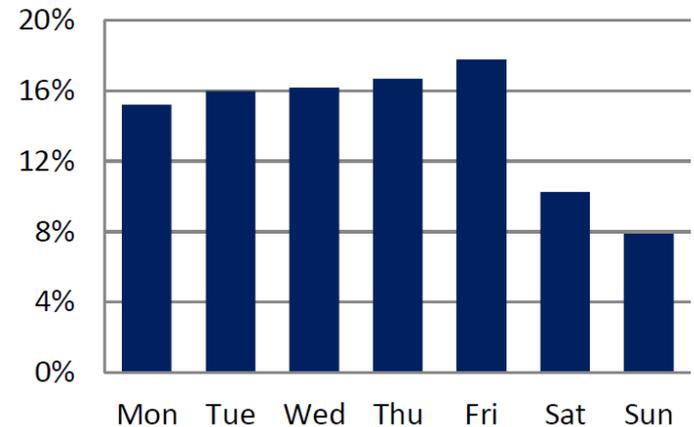
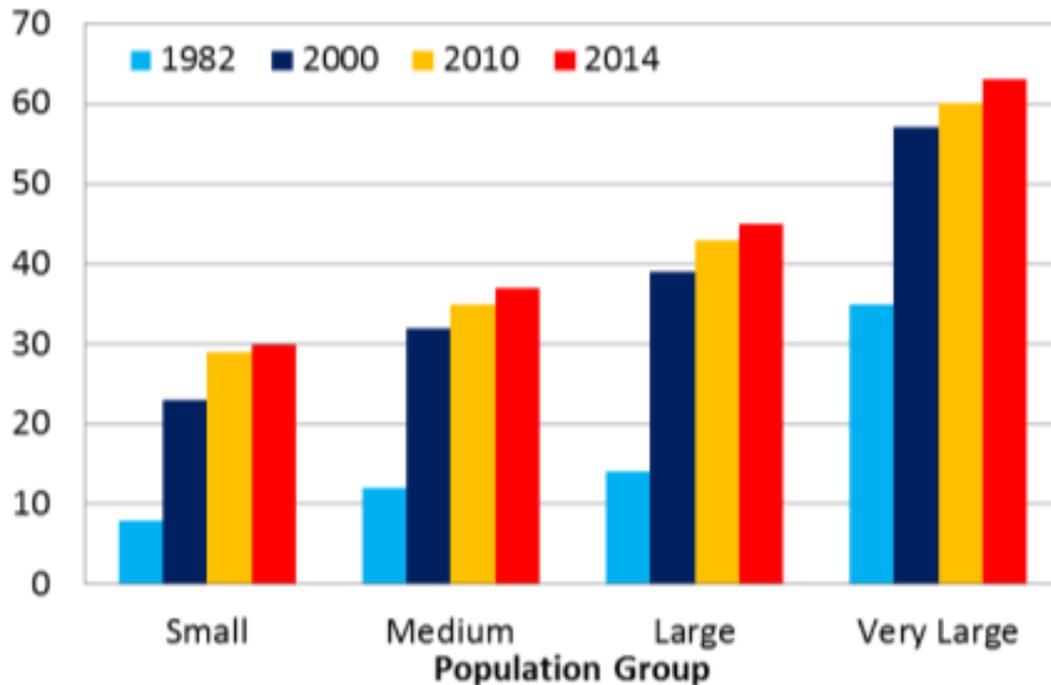
FOTW: Hybrid powertrain efficiency improvement vs. conventional counterparts varies (from ~25–75%).



intelligent transportation

TAMU: Traffic increase nationwide this decade, reasonably high traffic mid-day (non-peak)

Hours of delay per commuter per year in different metro sizes



topics

energy markets

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technologies studies

4 environmental studies

consumers/opinion surveys

policy studies

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4 environmental studies

diesel emissions

- > WVU/ICCT: vehicle nitrogen oxides emissions (but not CO₂) exceed legal limits.
- > ICCT/BBC: On-road emissions also exceed European regulations.

PEV emissions

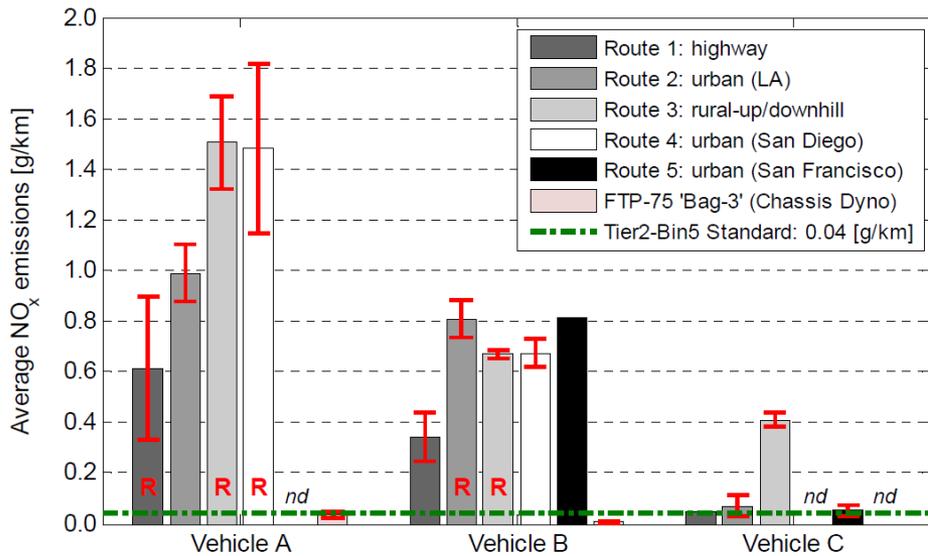
- > EPRI/NRDC: Current and projected plug-in electric greenhouse gases below similar conventional vehicles.
- > EPRI/NRDC: Ozone and sulfates from all sources (including vehicles) mostly reduced nationwide.
- > EPRI/NRDC: Nationwide on-road vehicular emissions projected to fall.
- > EPRI/NRDC: Nationwide emissions drop further with electrification.

grid emissions

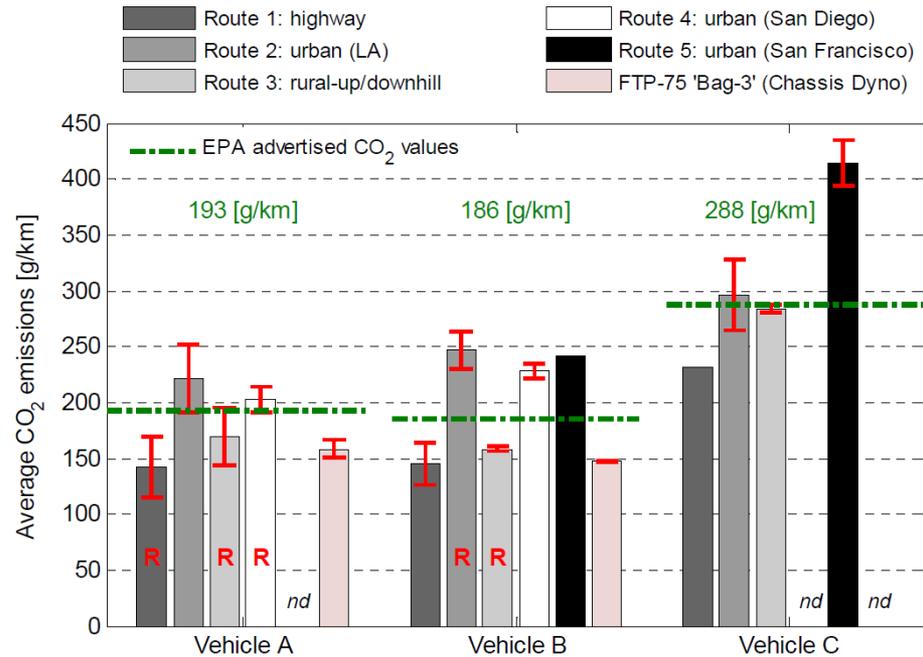
- > FOTW: New power generation facilities will differ by technology and geography than those retired.
- > EIA: New coal mine starts continue to decline (>60% from their 10-year peak).
- > EIA: U.S. Power sector carbon dioxide emissions reach 27-year low in April.
- > EIA: Electricity from natural gas surpasses coal for first time (but just for one month).

diesel emissions studies

WVU/ICCT: vehicle nitrogen oxides emissions (but not CO₂) exceed legal limits.



NOx emissions for test vehicles

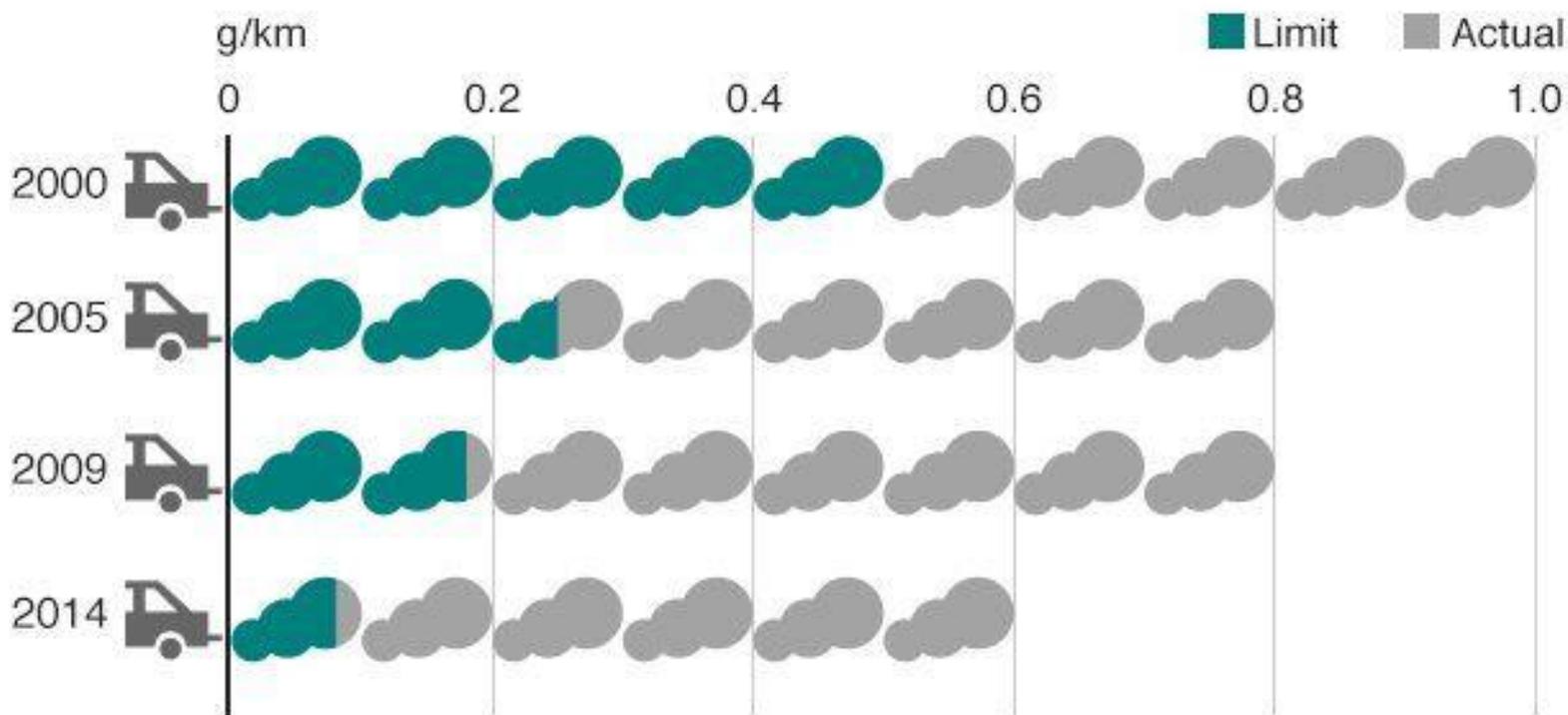


CO₂ emissions for test vehicles

diesel emissions studies

ICCT/BBC: On-road emissions also exceed European regulations.

Diesel cars break nitrogen oxide emission limits

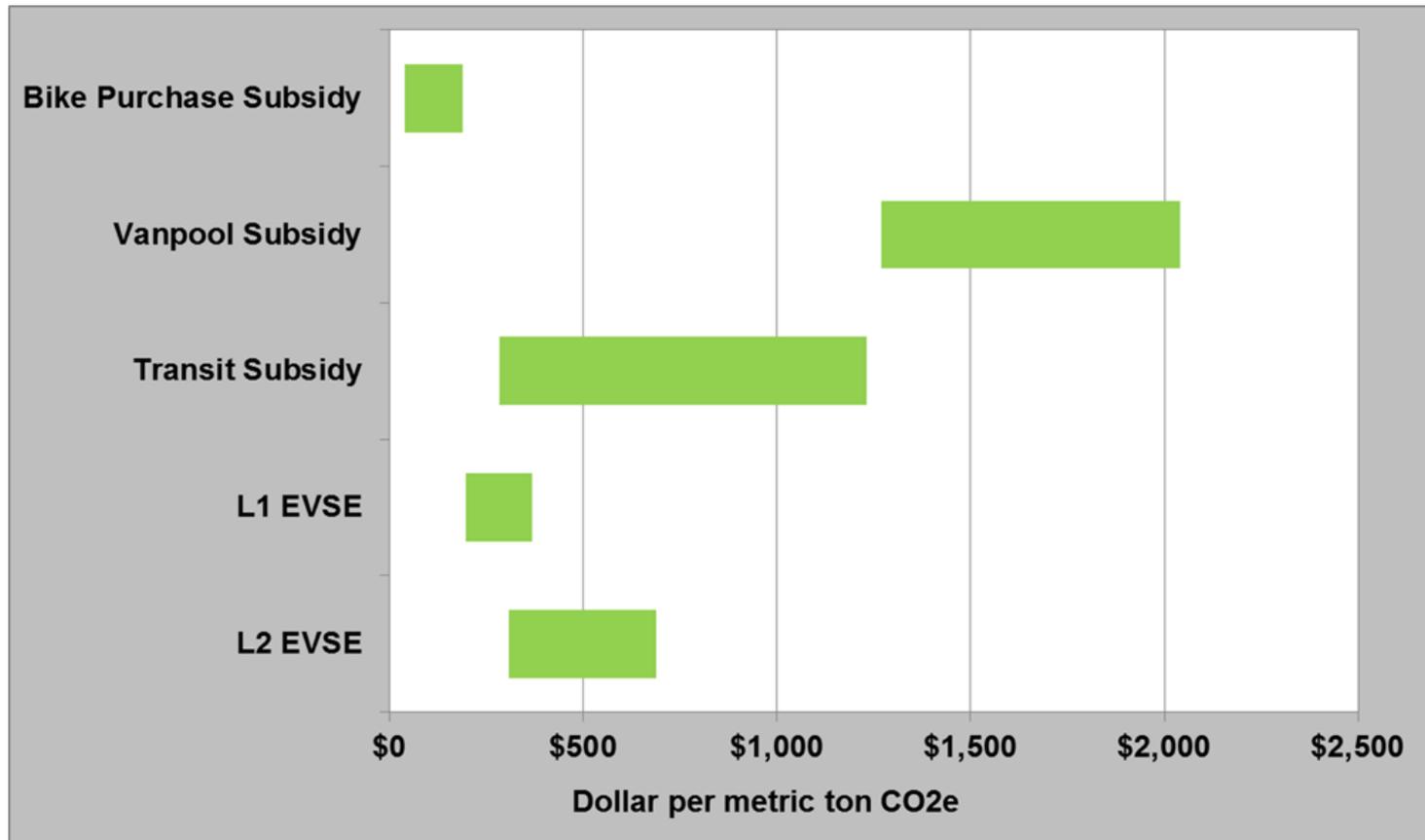


Source: ICCT



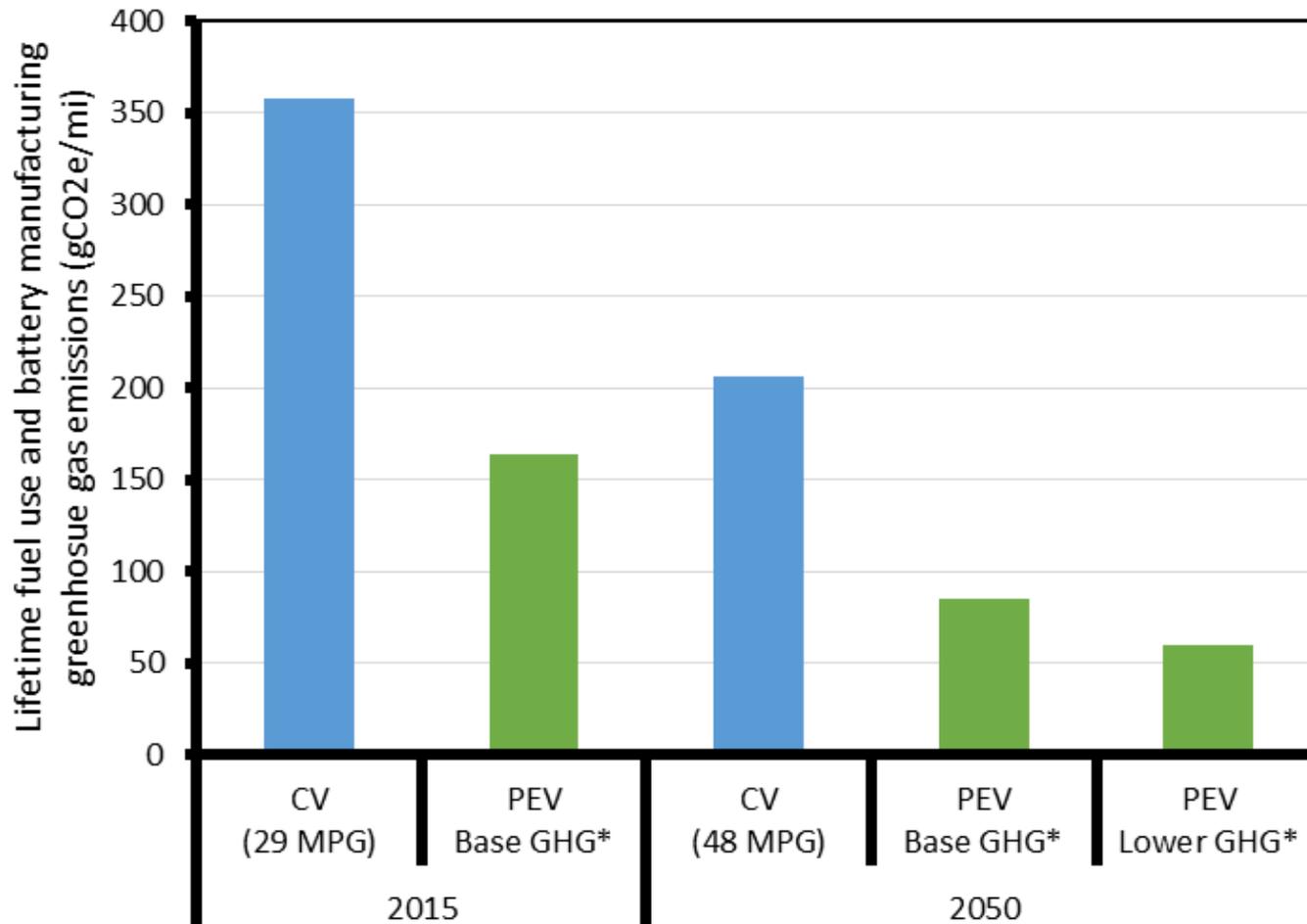
PEV emissions studies

WPC/FOTW: Workplace charging GHG abatement cost (already) compares to other commuting alternatives.



PEV emissions studies

EPRI/NRDC: Current and projected plug-in electric greenhouse gases below similar conventional vehicles.

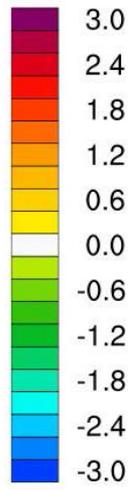
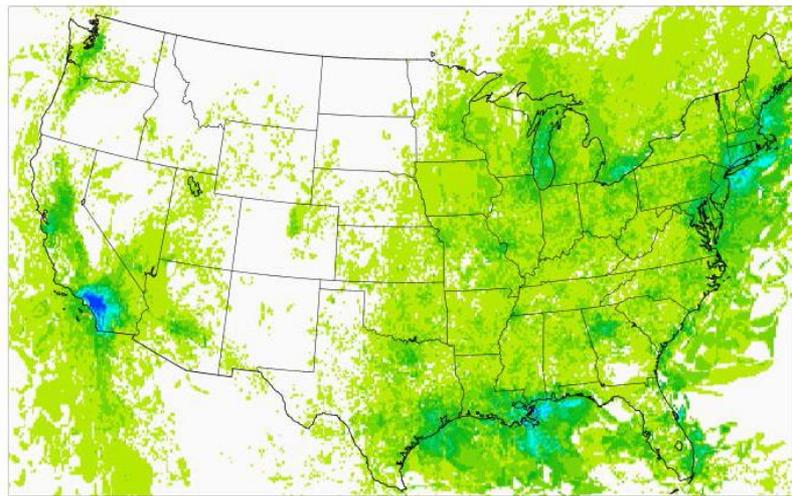


PEV emissions studies

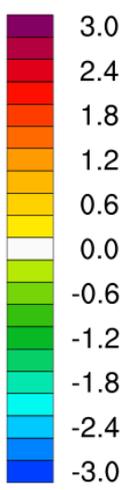
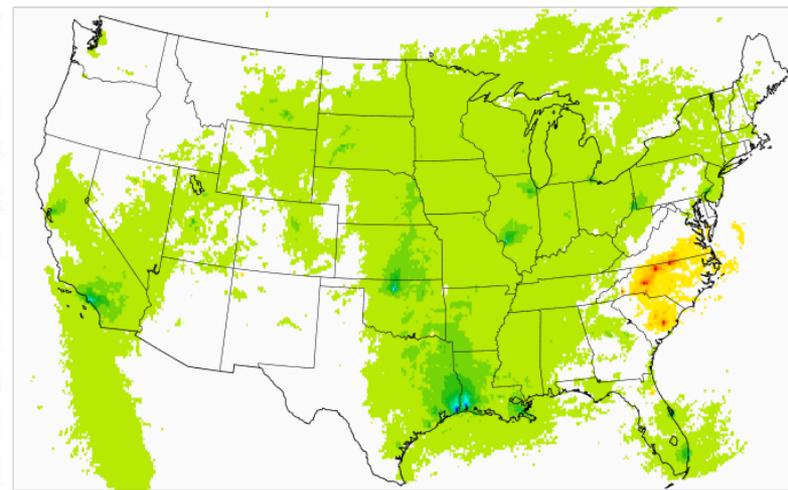
EPRI/NRDC: Ozone and sulfates from all sources (including vehicles) mostly reduced nationwide.

CAMx 2030 Elec - noElec
4th Highest Daily Max 8-hour Ozone

2030 (Elec - noElec) / noElec
Annual Deposition of Sulfate



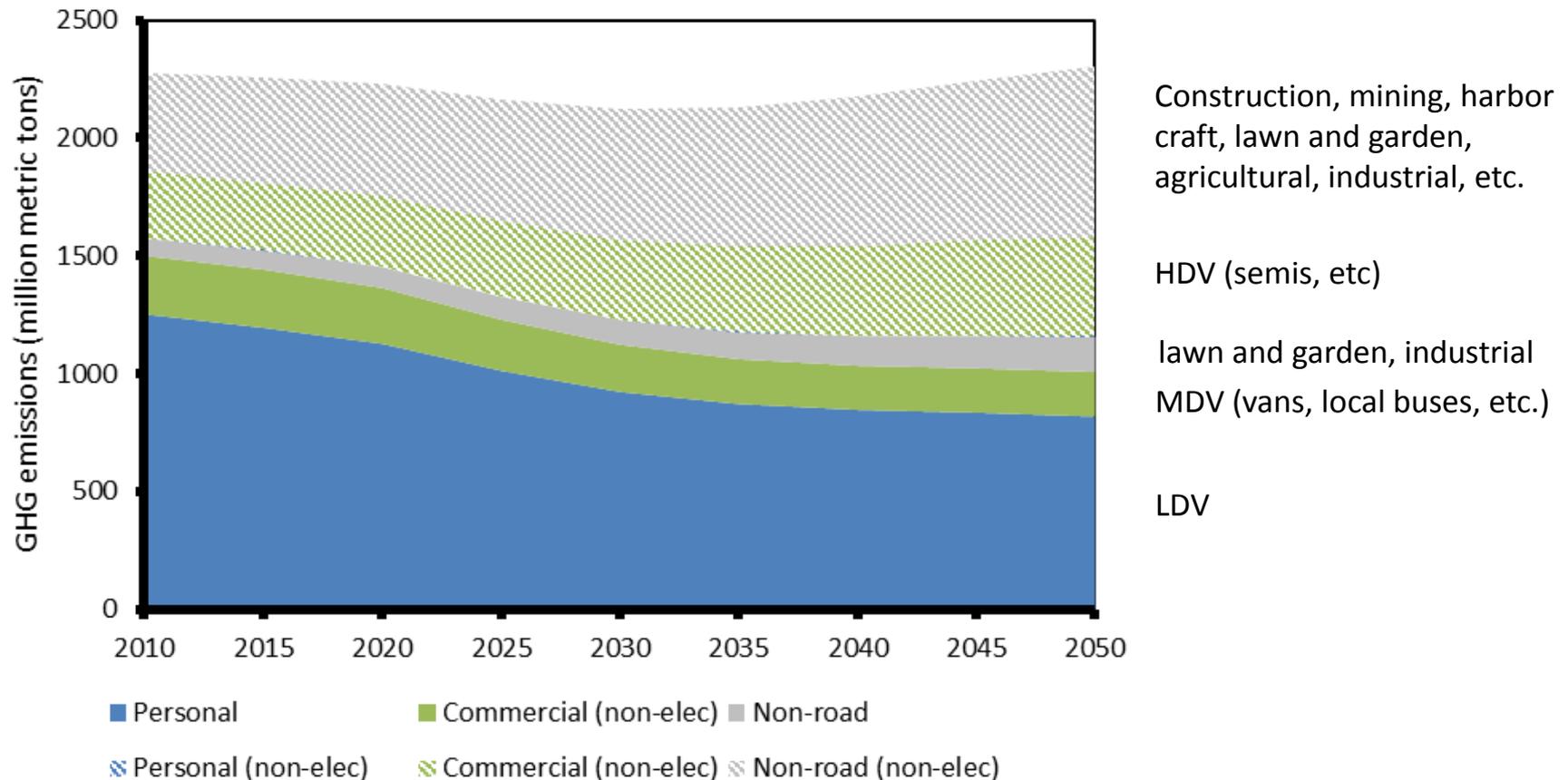
ppb



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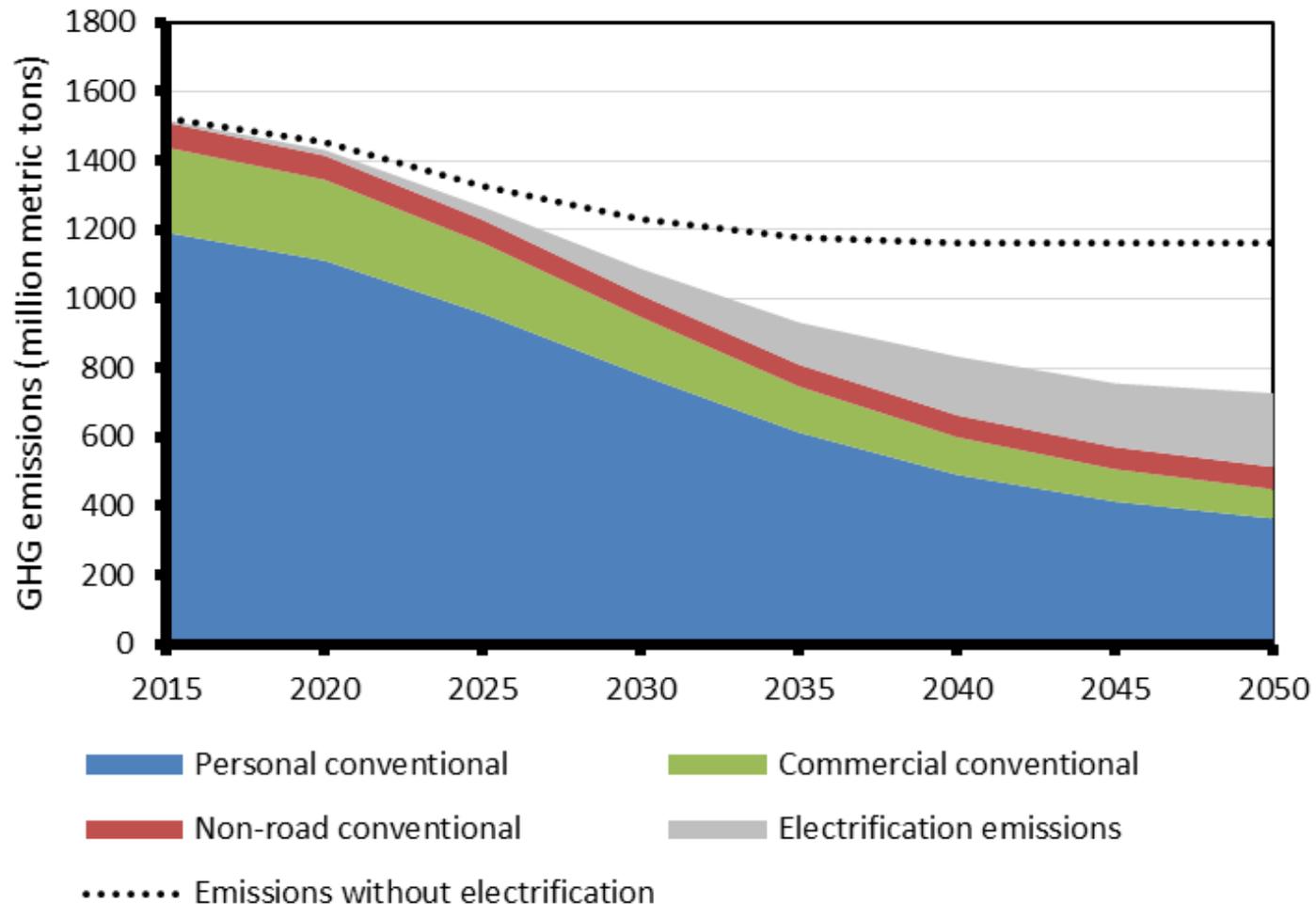
PEV emissions studies

EPRI/NRDC: Nationwide on-road vehicular emissions projected to fall through 2050.



PEV emissions studies

EPRI/NRDC: Nationwide emissions drop further with electrification.

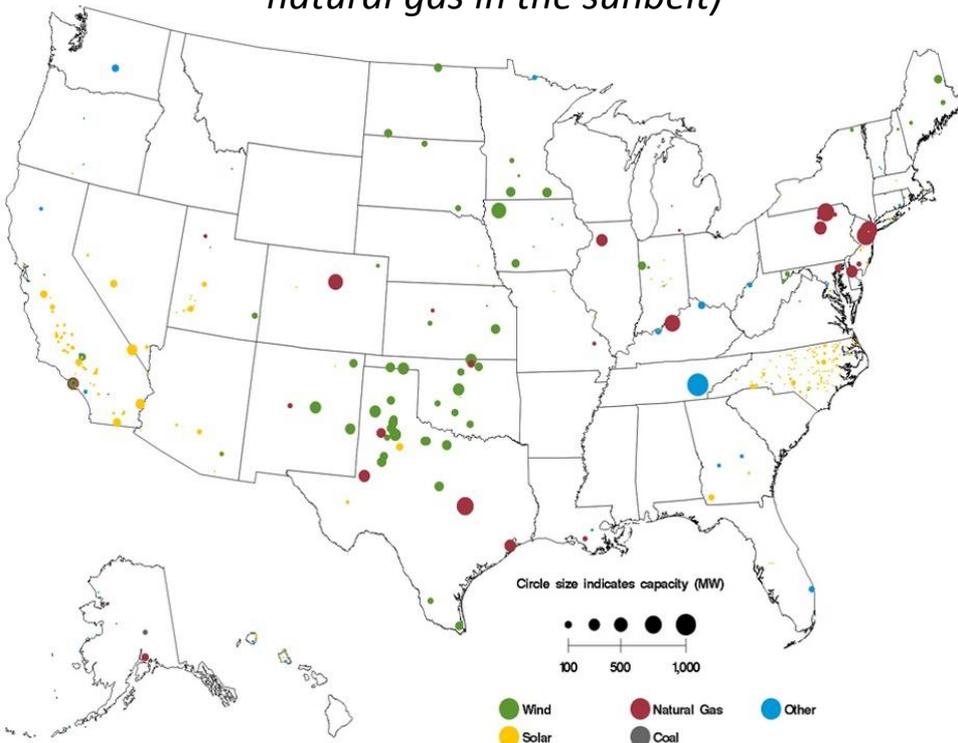


grid emissions studies

FOTW: New power generation facilities will differ by technology and geography than those retired.

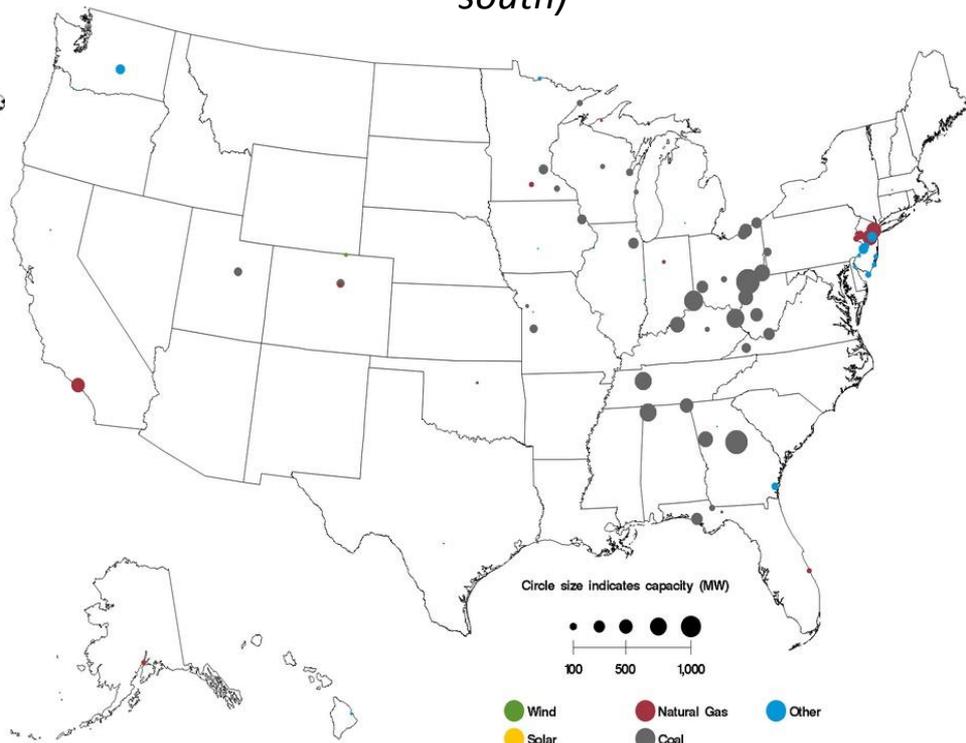
Planned additions

(primarily wind, solar, and natural gas in the sunbelt)



Planned retirements

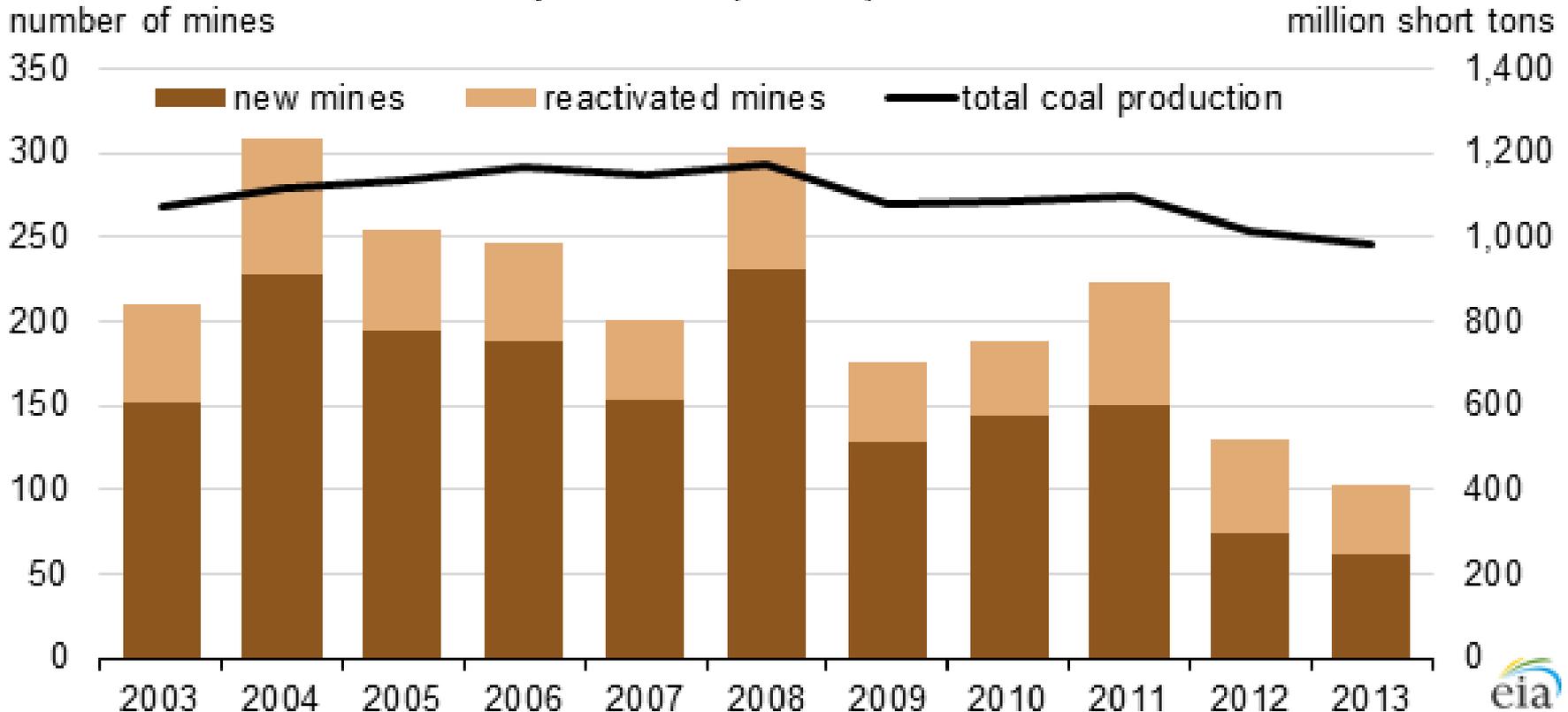
(primarily coal in the mid-west, south)



grid emissions studies

EIA: New coal mine starts continue to decline (>60% from their peak in the past 10 years).

U.S. coal mine starts and total production (2003-13)

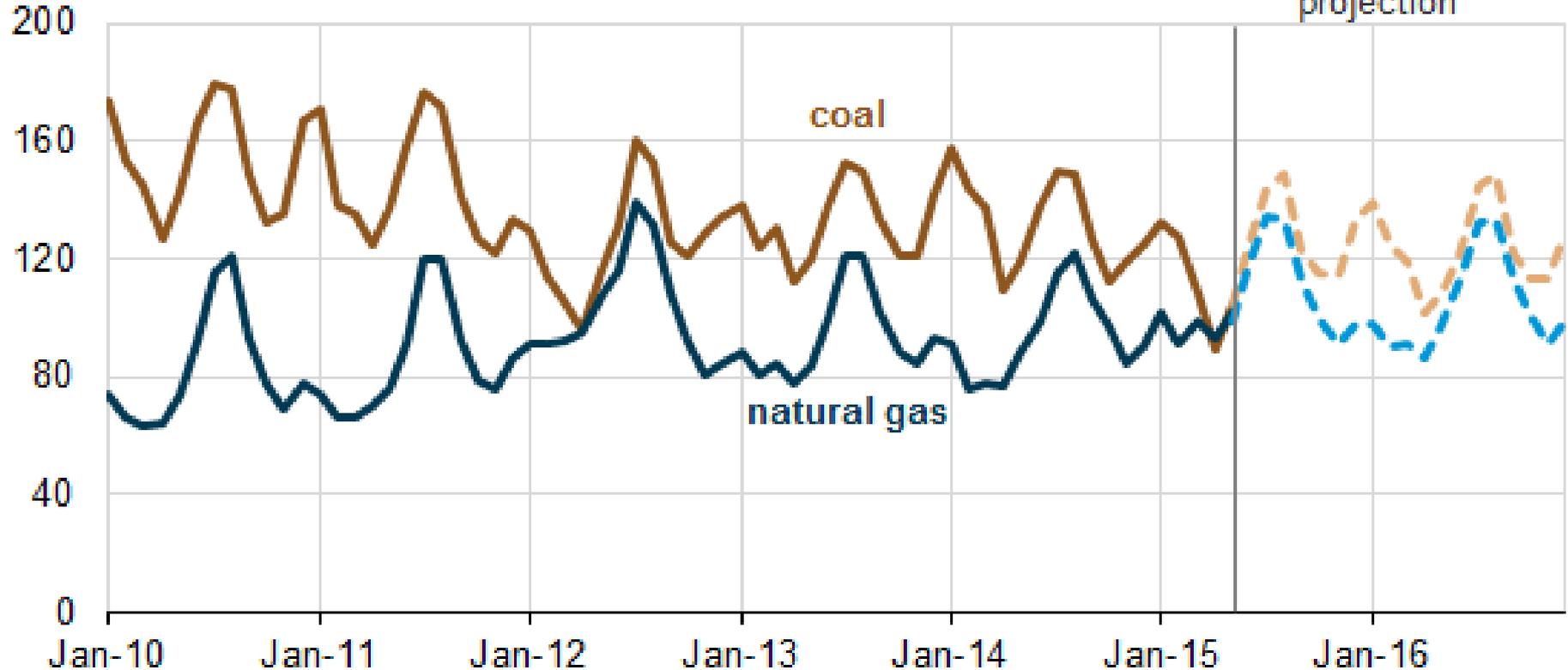


grid emissions studies

EIA: Electricity from natural gas surpasses coal for first time (but just for one month).

U.S. net electricity generation, selected fuels (2010-16)

gigawatthours

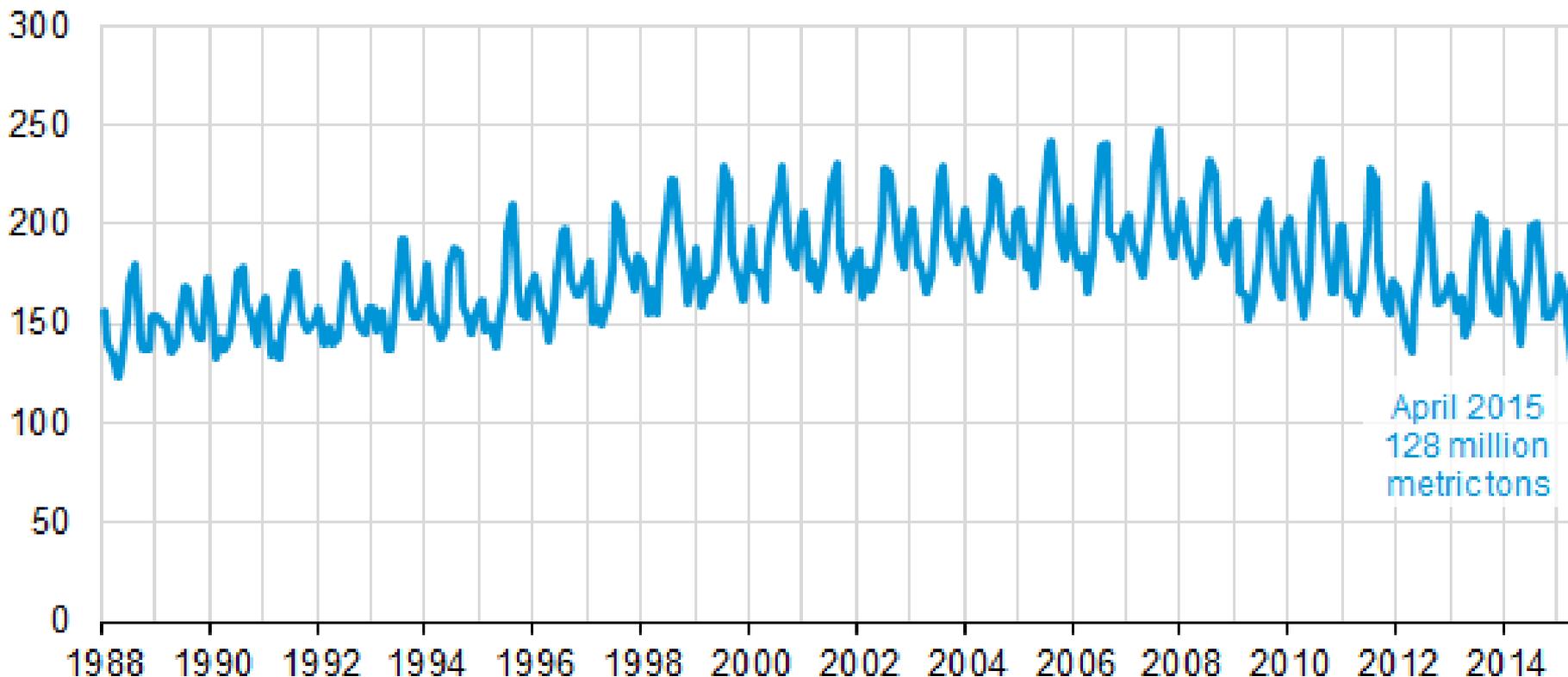


projection

grid emissions studies

EIA: U.S. Power sector carbon dioxide emissions reach 27-year low in April.

U.S. carbon dioxide emissions from the electric power sector (Jan 1988-Apr 2015)
million metric tons



topics

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environmental studies

5 consumers/opinion surveys

policy studies

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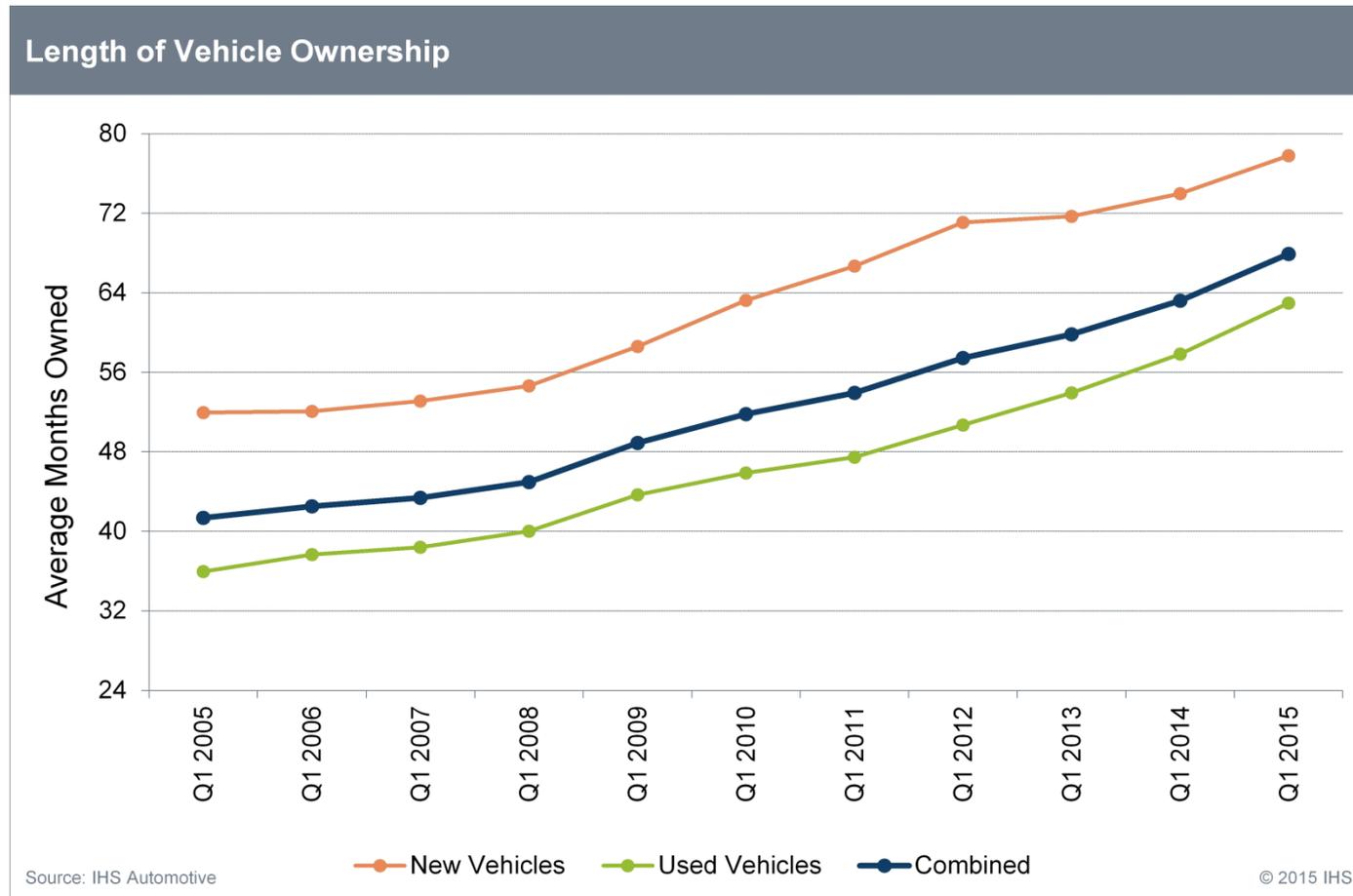
5 consumer & opinion surveys

consumer preferences

- > IHS: Customers holding cars longer (both new and used).
- > NREL: Consumer Views on Transportation and Advanced Vehicle Technologies Report is online.
- > NREL: Attribute importance for vehicle choice changes (sometimes dramatically) over time.
- > NREL: Surveys suggest <20% of consumers accept a payback of 5 years; <33% 3 years; <66% 1 year.

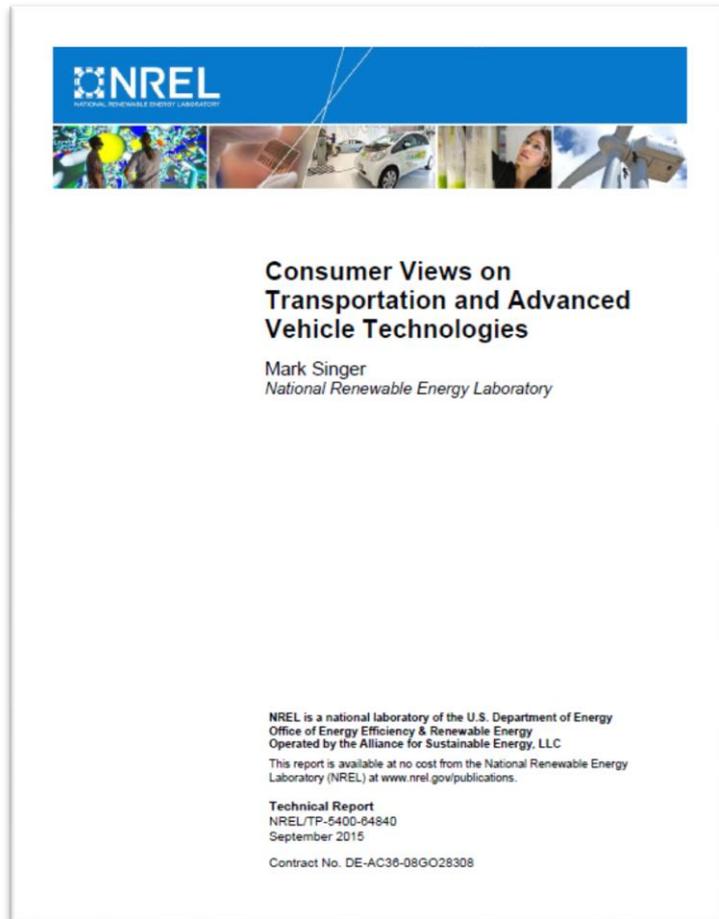
consumer preferences

IHS: Customers' vehicle ownership periods (both new and used) are growing longer.



consumer preferences

NREL: Consumer Views on Transportation and Advanced Vehicle Technologies Report is online.



- This report summarizes study data captured from December 2005 through June 2015 relevant to Vehicle Technologies Office research efforts at the time of the studies:
 - Vehicle fuel economy
 - Future vehicle technology alternatives
 - Ethanol as a vehicle fuel
 - Plug-in electric vehicles, and
 - Willingness to pay for vehicle efficiency

consumer preferences

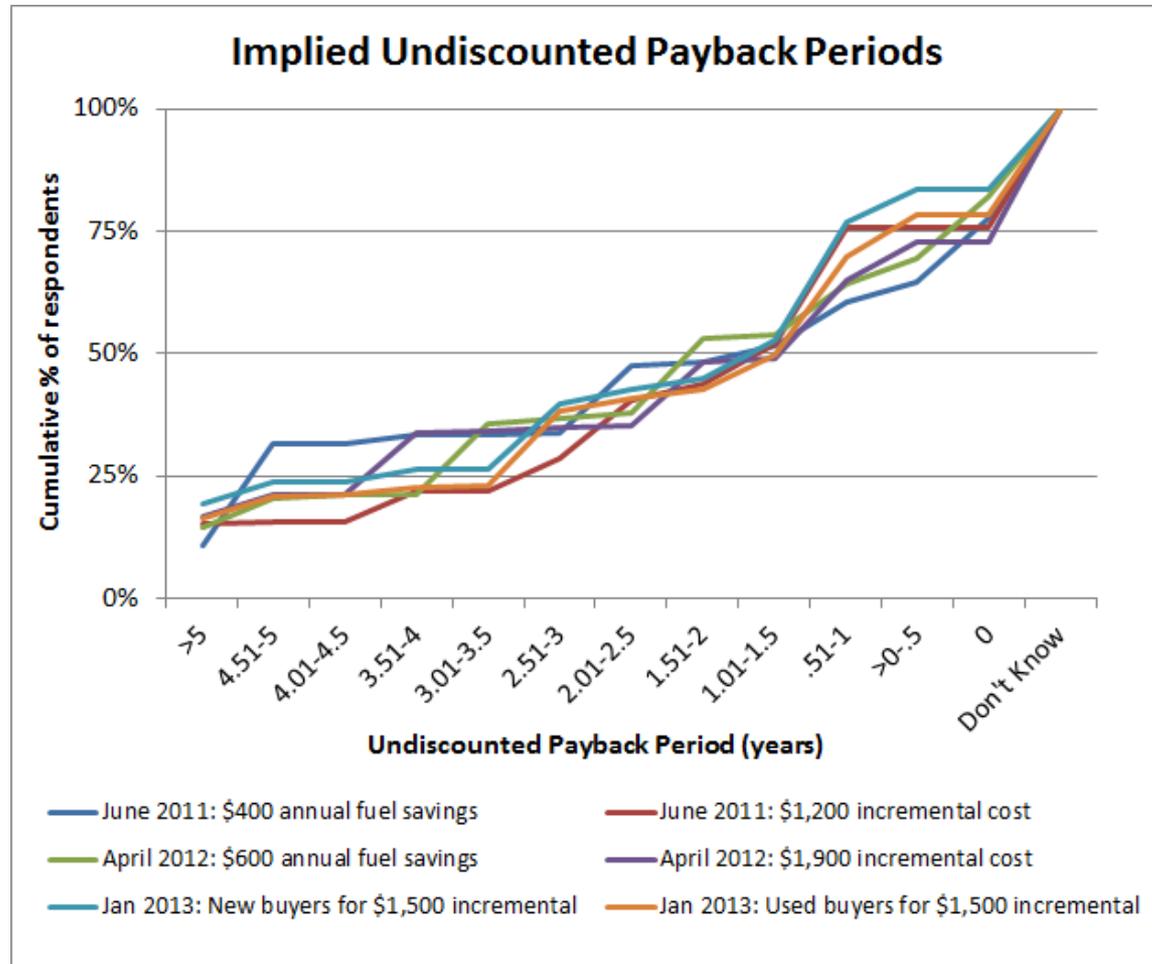
NREL: Attribute importance for vehicle choice changes (sometimes dramatically) over time.

“Which one of the following attributes would be MOST IMPORTANT in your choice of your next vehicle?”

Date of Study	Fuel Economy	Dependability	Low price	Quality	Safety	Don't Know
1980	42%	31%	14%	4%	9%	
1981	20%	40%	21%	7%	12%	
1983	13%	38%	30%	11%	9%	
1985	8%	41%	29%	12%	10%	
1987	4%	44%	31%	8%	14%	
1996	7%	34%	11%	19%	29%	
1998	4%	36%	5%	20%	34%	1%
2000	10%	32%	11%	21%	24%	2%
2001	10%	29%	8%	22%	29%	1%
May 2004	22%	26%	10%	19%	23%	
May 2005	12%	33%	6%	20%	26%	3%
Jun 2006	19%	27%	6%	19%	25%	4%
Aug 2007	21%	30%	7%	17%	24%	3%
Aug 2008	26%	26%	8%	15%	22%	2%
Aug 2009	23%	28%	9%	19%	17%	5%
Jun 2011	29%	22%	7%	19%	21%	1%
Nov 2012	27%	23%	13%	15%	14%	7%
Jun 2014	20%	29%	11%	19%	19%	2%
Jun 2015	13%	31%	14%	18%	21%	3%

consumer preferences

NREL: Surveys suggest <20% of consumers accept a payback of 5 years; <33% 3 years; <66% 1 year.



topics

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6 **policy studies**

qar
outline

6 policy studies

PEV incentives

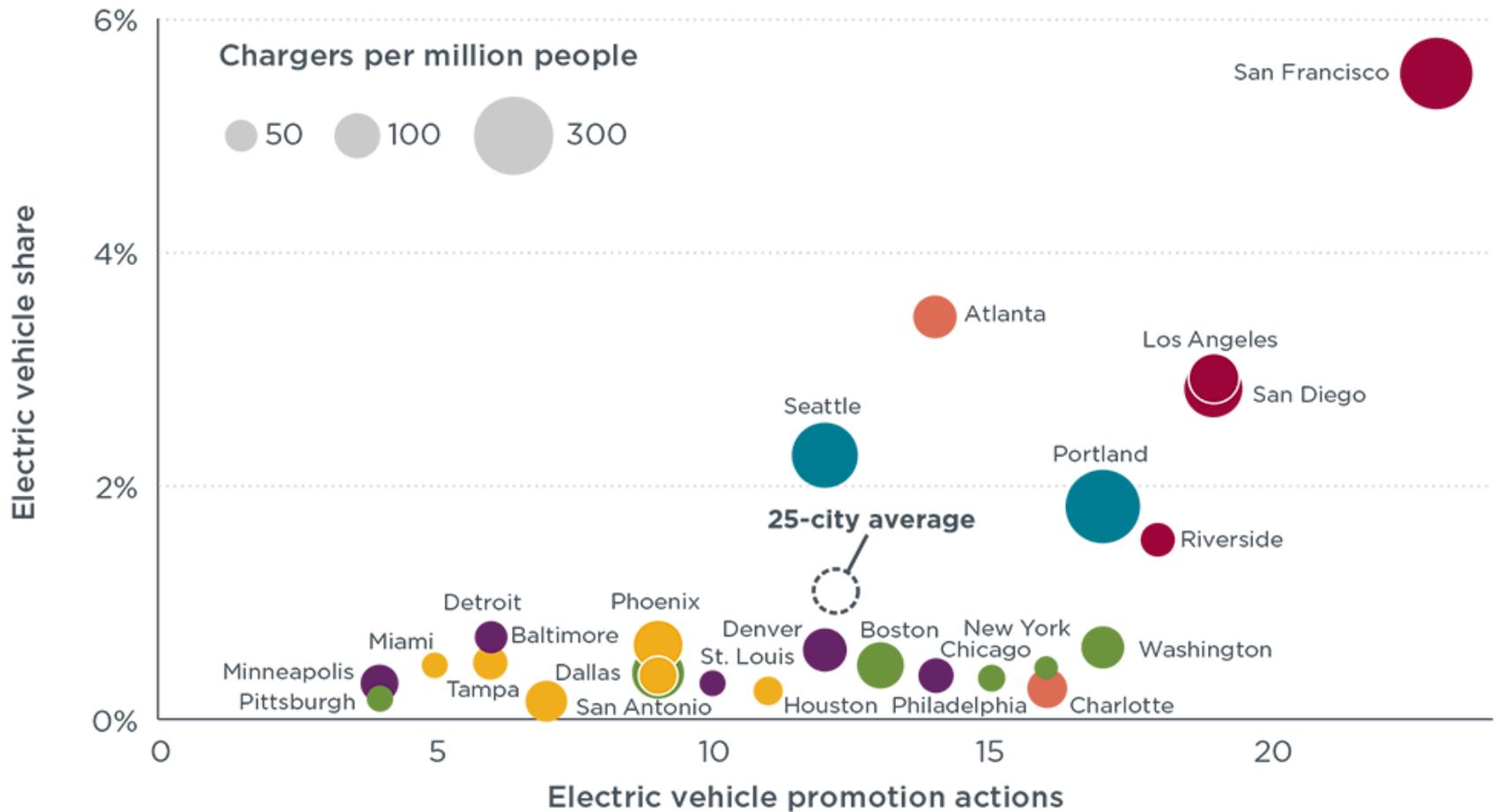
- > ICCT: PEV sales are [generally] positively correlated with PEV promotion policies.
- > ICCT: ...but PEV sales aren't necessarily directly correlated with either EVSE or other policy promotion.
- > ICCT: BEV occur in largest cities.
- > FOTW: State incentives for PEVs vary widely (from \$0 to \$6,000).
- > ORNL: State incentives for EVSE also vary widely (by amount and format).
- > UC-Berkeley: Most government PEV incentives go to relatively wealthy.
- > SRA: OEM incentives also reduce PEV incremental price in the current market.
- > SRA: Some OEM incentives are more aligned with ZEV states than others.

general awareness

- > ORNL: Transportation Energy Data Book, edition 34 is available online.

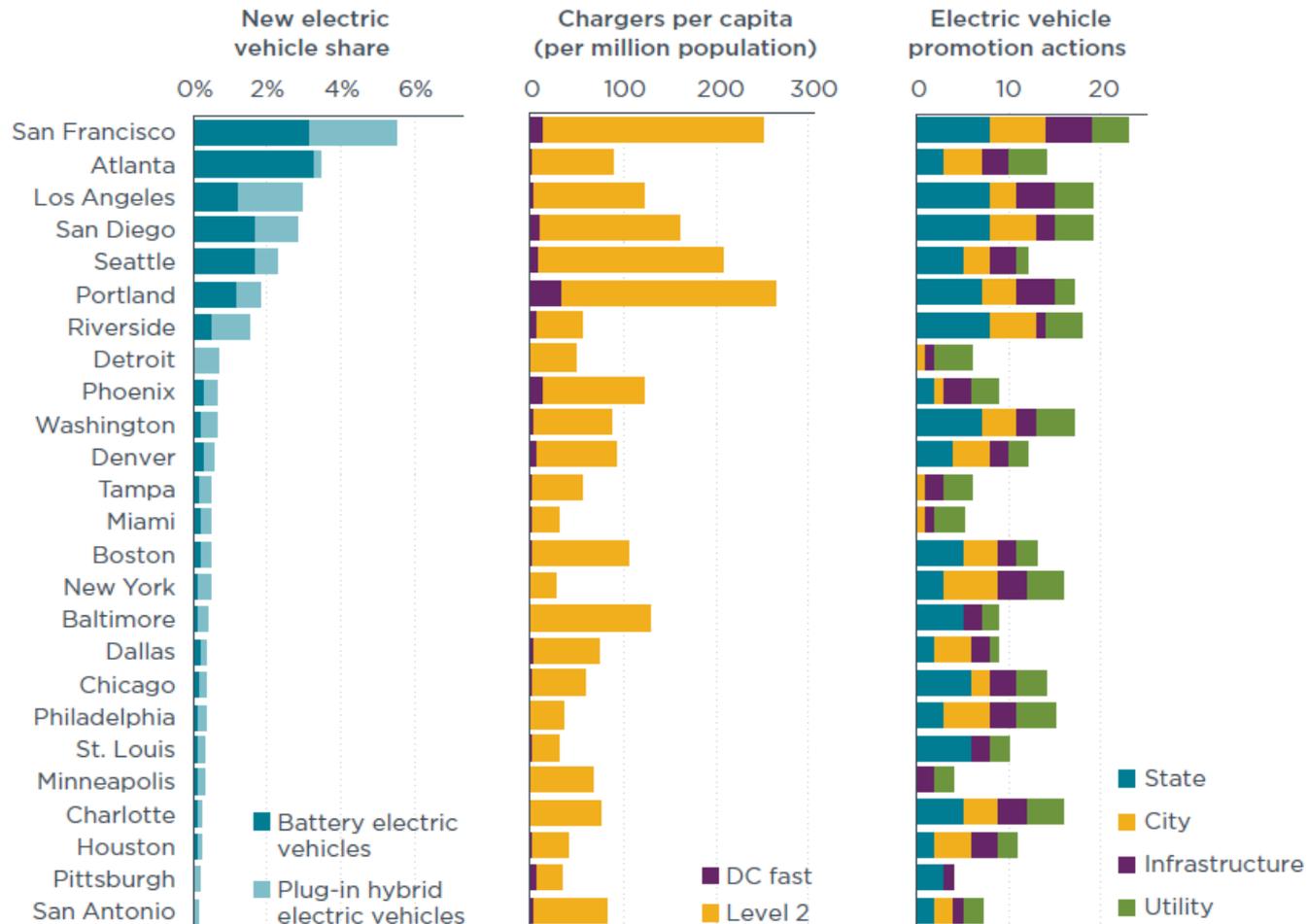
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PEV incentives

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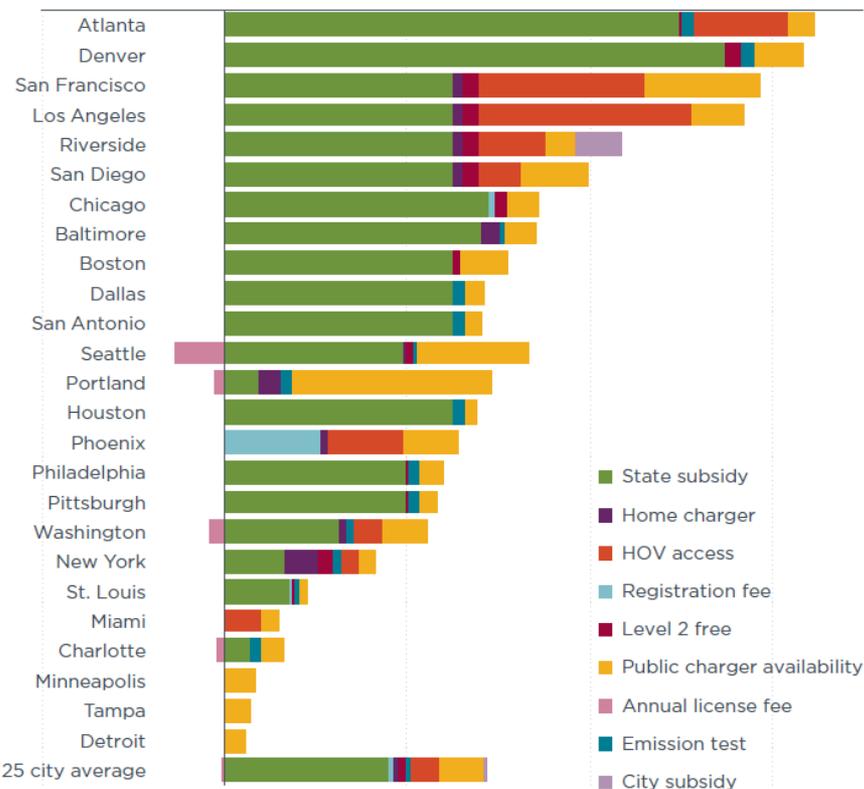


PEV incentives

ICCT: Total monetized consumer benefits for PHEV and BEV occur in largest cities.

Battery electric vehicle consumer benefit

\$0 \$2,000 \$4,000 \$6,000



Plug-in hybrid electric vehicle consumer benefit

\$0 \$1,000 \$2,000 \$3,000 \$4,000

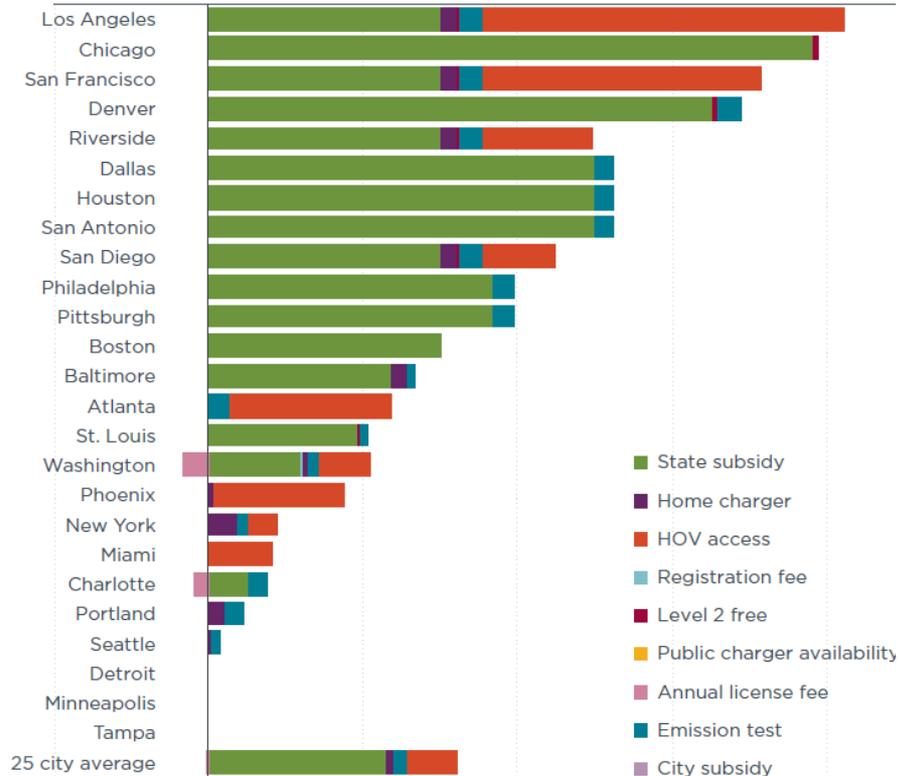
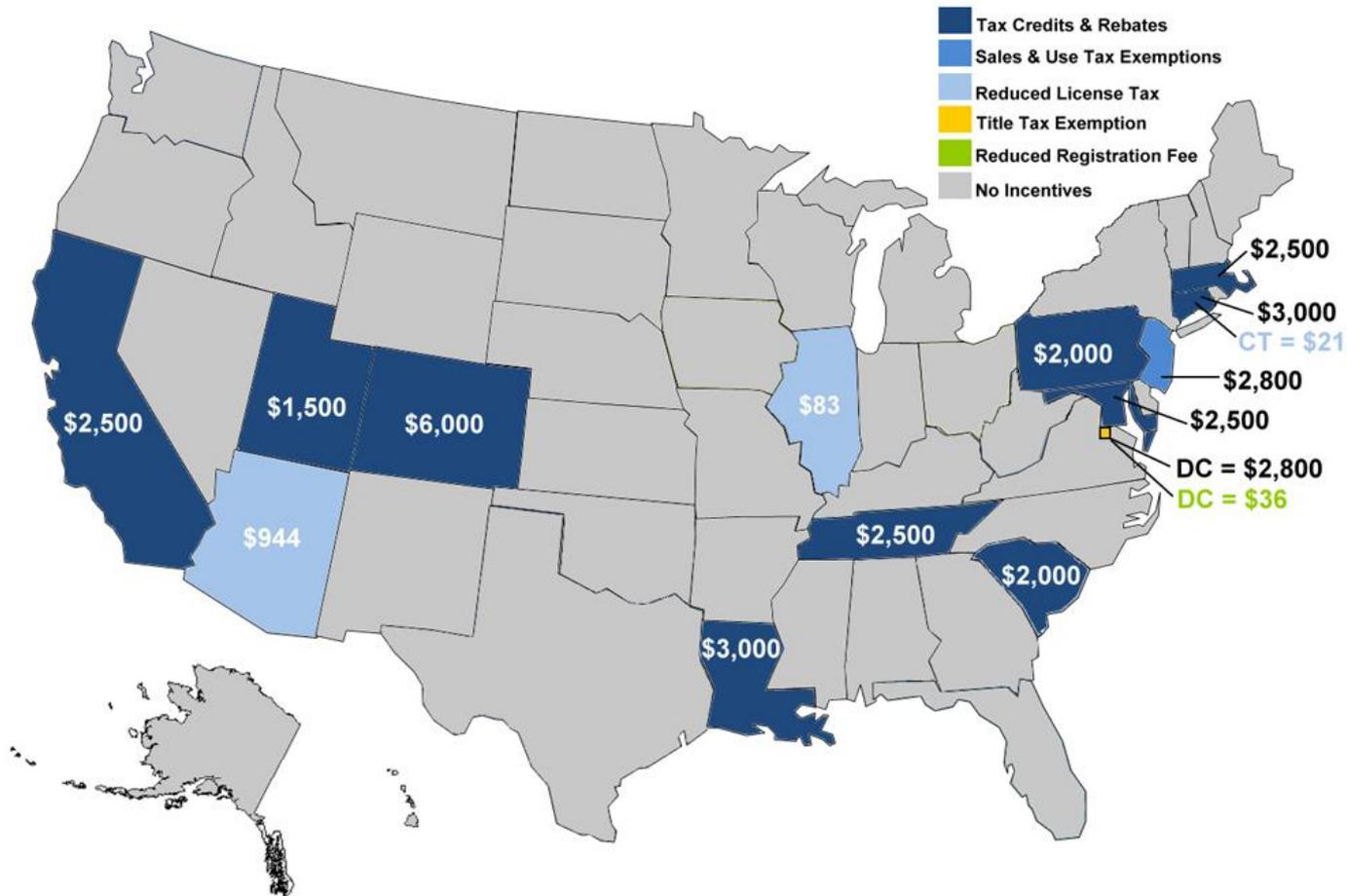


Figure 6. Summary of battery electric vehicle consumer benefits from electric vehicle policy actions across 25 most populous U.S. cities in 2014

Figure 7. Summary of plug-in hybrid electric vehicle consumer benefits from electric vehicle policy actions across 25 most populous U.S. cities in 2014

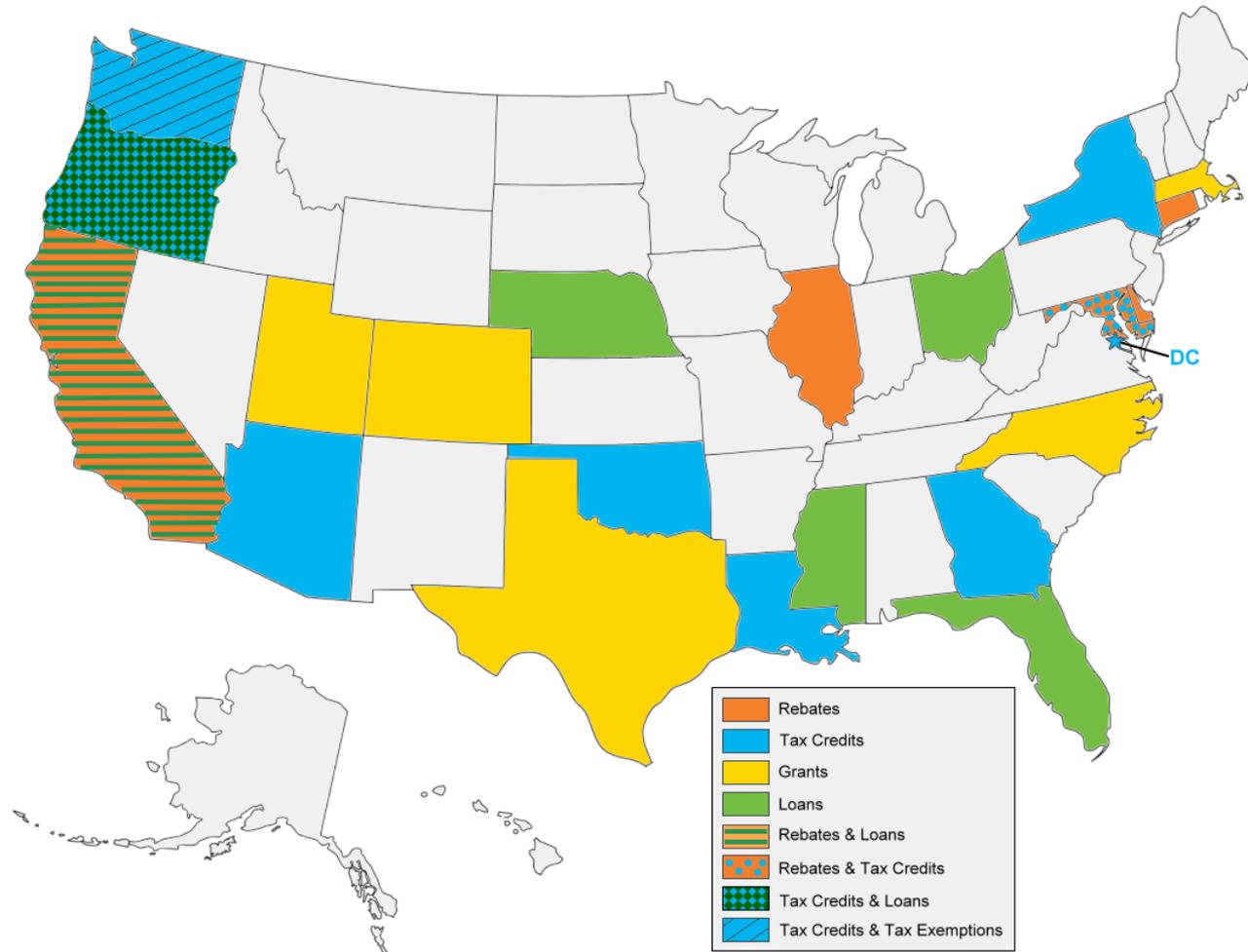
PEV incentives

FOTW: State incentives for PEVs vary widely (from \$0 to \$6,000).



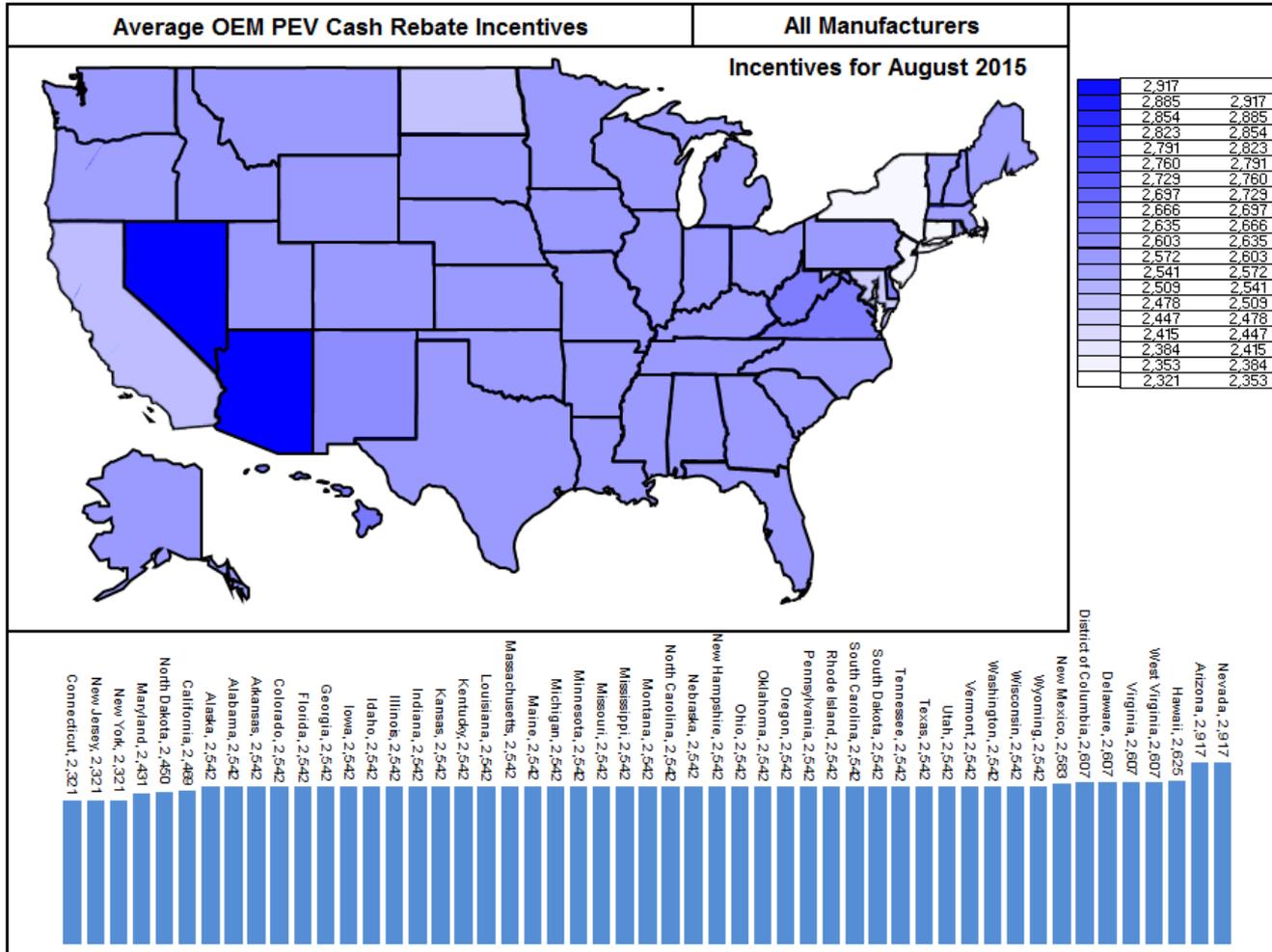
PEV incentives

ORNL: State incentives for EVSE also vary widely (by amount and format).



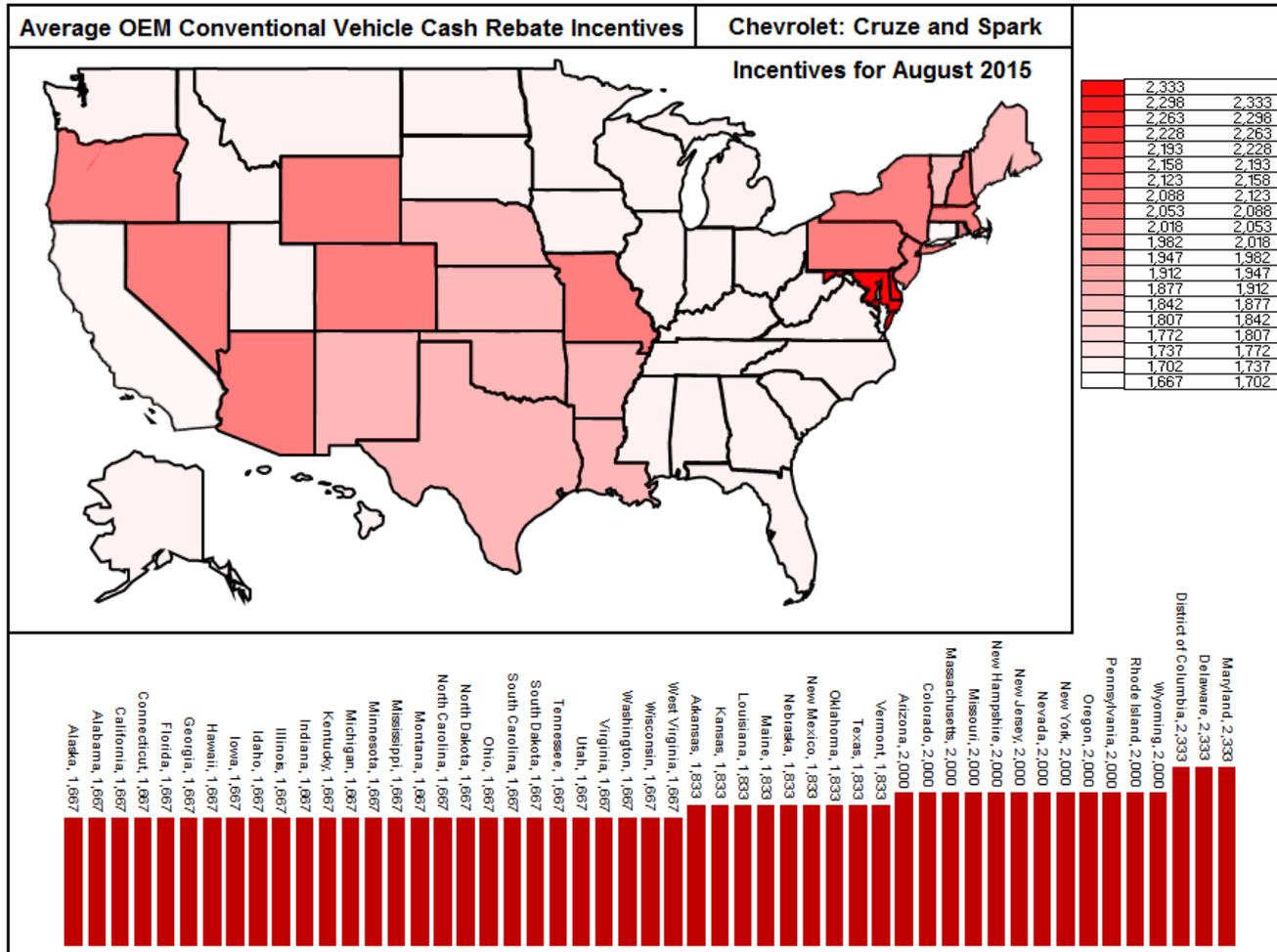
PEV incentives

SRA: OEM incentives also reduce PEV incremental price in the current market.



PEV incentives

SRA: Some OEM incentives are more aligned with ZEV states than others.

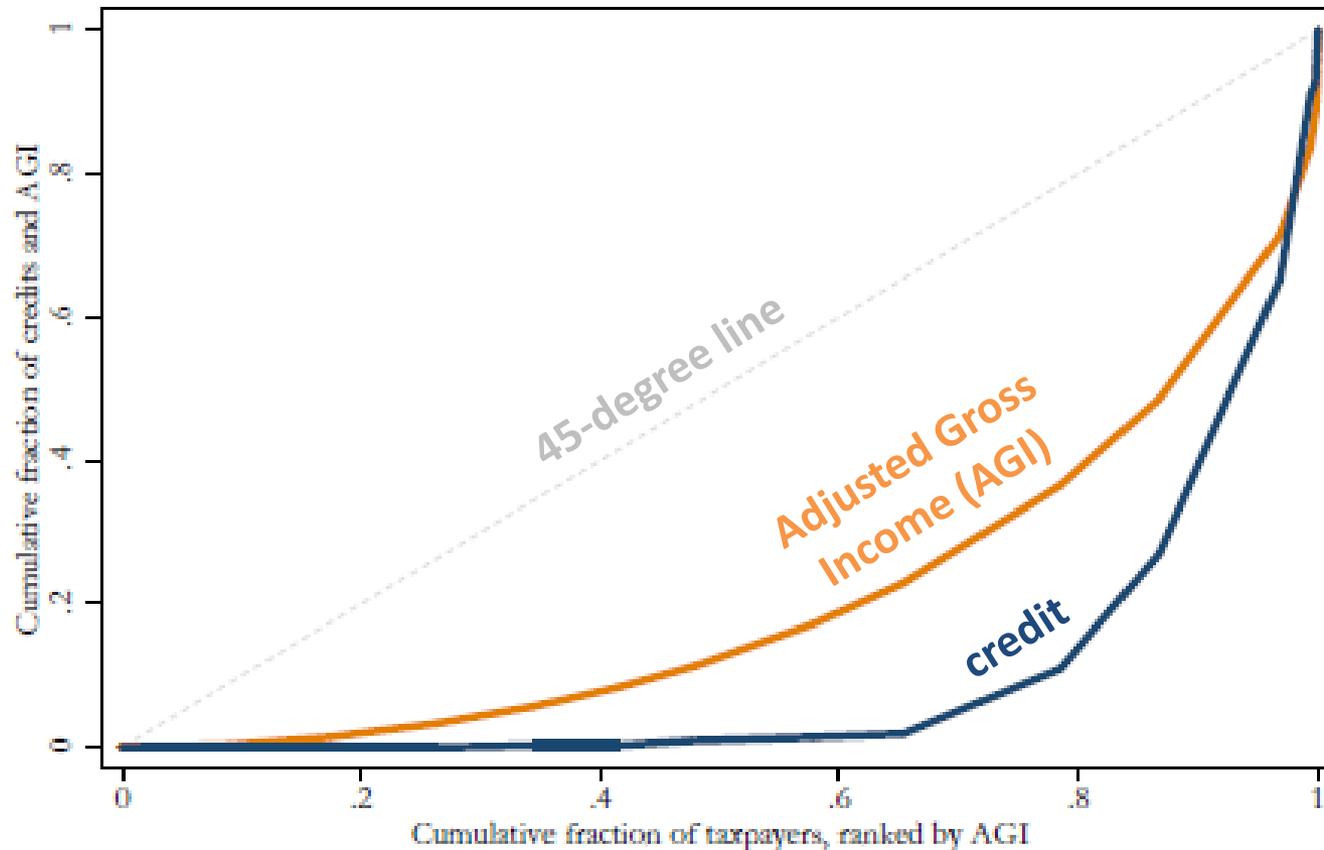


Incentives shown range from ~\$1,600-\$2,300.

PEV incentives

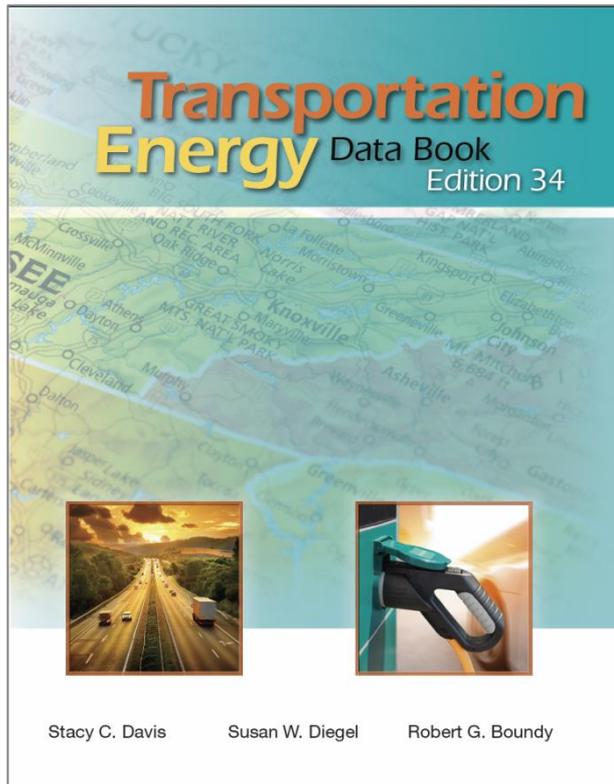
UC-Berkeley: Most PEV buyers claiming incentives are relatively wealthy.

C: Qualified Plug-in Electric Drive Motor Vehicle Credit, 2009-2012



general awareness

ORNL: Transportation Energy Data Book, edition 34 is available online.



Printed copies are coming.

<http://cta.ornl.gov/data>

Transportation Energy Data Book OAK RIDGE National Laboratory

Edition 34 Released September 30, 2015

The *Transportation Energy Data Book* (TEDB) is a compendium of data on transportation with an emphasis on energy. Designed for use as a desktop reference, the TEBD was first published in 1976 and has continued to Edition 34. The TEBD is produced by Oak Ridge National Laboratory for the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy. More...

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"Petroleum comprised 92% of U.S. transportation energy use in 2014."

Table 2.2 Distribution of Energy Consumption by Source, 1973 and 2014

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- Errors
- Omissions
- Emphases
- Organization

Related Websites:

- Fact of the Week
- 2014 Vehicle Technologies Market Report
- Hydrogen Data Book

Excel and PDF formats available.

summary observations



energy

Gas prices are low; U.S. production continues to increase; though, a near-term peak is expected

automotive

U.S. PEV sales have slowed; globally, the 1,000,000th PEV milestone was achieved

tech/enviro

diesel LDV scandal rocks headlines; PEV increasingly benefit from cleaner (GHG and other emissions) grids

opinion/policy

PEV incentives continue to vary greatly from state to state but are generally positively correlated with PEV sales; consumer preferences are (as always) complicated.

15.2
2Q 2015

qar
summary