1. topics
   - energy markets
   - automotive markets
   - technologies studies
   - environmental studies
   - consumer & opinion surveys
   - policy studies

qar outline
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
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

gasoline prices

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

Figure 1. Crude oil and petroleum product prices

dollars per barrel

189
168
147
126
105
84
63
42
21
0


Source: U.S. Energy Information Administration, Short-Term Energy Outlook, February 2016

Source: http://www.eia.gov/petroleum/weekly/archive/2016/160210/includes/analysis_print.cfm
EIA: Oil inventory levels are well above their average over the previously 5-years.

Source: http://www.eia.gov/todayinenergy/detail.cfm?id=24832
EIA: Near-term increase projected in petroleum production worldwide, but decrease in U.S.

Source: [http://www.eia.gov/todayinenergy/detail.cfm?id=24832](http://www.eia.gov/todayinenergy/detail.cfm?id=24832)
oil markets

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

topics
energy markets
automotive markets
technologies studies
environmental studies
consumers/opinion surveys
policy studies

2

qar

outline
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

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

- December 2015 sales were the highest since July 2005 with 1.64M units sold.

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

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

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

BEV markets

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

<table>
<thead>
<tr>
<th>US 2015 models</th>
<th>Resale value</th>
<th>Upfront cost</th>
<th>Running cost</th>
<th>TCO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chevrolet Cruze</td>
<td>-5,195</td>
<td>20,403</td>
<td>8,855</td>
<td>24,063</td>
</tr>
<tr>
<td>Ford Fusion</td>
<td>-6,617</td>
<td>25,988</td>
<td>9,042</td>
<td>28,414</td>
</tr>
<tr>
<td>Chevrolet Malibu</td>
<td>-6,544</td>
<td>25,702</td>
<td>9,882</td>
<td>29,040</td>
</tr>
<tr>
<td>Toyota Camry</td>
<td>-6,748</td>
<td>26,504</td>
<td>9,333</td>
<td>29,089</td>
</tr>
<tr>
<td>Honda Accord</td>
<td>-6,921</td>
<td>27,185</td>
<td>9,025</td>
<td>29,289</td>
</tr>
<tr>
<td>Chevrolet Volt</td>
<td>-5,165</td>
<td>24,334</td>
<td>6,950</td>
<td>26,119</td>
</tr>
<tr>
<td>Ford Fusion Energi</td>
<td>-5,399</td>
<td>24,841</td>
<td>7,133</td>
<td>26,575</td>
</tr>
<tr>
<td>Ford C-MAX Energi</td>
<td>-4,802</td>
<td>25,492</td>
<td>6,996</td>
<td>27,686</td>
</tr>
<tr>
<td>Toyota Prius PHEV</td>
<td>-4,905</td>
<td>27,653</td>
<td>7,102</td>
<td>29,850</td>
</tr>
<tr>
<td>Chevrolet Spark EV</td>
<td>-3,837</td>
<td>14,744</td>
<td>5,917</td>
<td>16,824</td>
</tr>
<tr>
<td>Ford Focus EV</td>
<td>-4,413</td>
<td>18,456</td>
<td>6,188</td>
<td>20,231</td>
</tr>
<tr>
<td>Nissan Leaf</td>
<td>-4,851</td>
<td>21,280</td>
<td>6,234</td>
<td>22,663</td>
</tr>
<tr>
<td>Kia Soul EV</td>
<td>-5,249</td>
<td>23,850</td>
<td>6,462</td>
<td>25,063</td>
</tr>
</tbody>
</table>

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/](http://www.bcse.org/sustainableenergyfactbook/)
3 topics
energy markets
automotive markets
3 technologies studies
environmental studies
consumers/opinion surveys
policy studies
qar outline
25
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
EPA: Light-duty fuel economy has improved over the past decade...

Light-Duty Fuel Economy Trends

vehicle performance

EPA: ... and acceleration has been improving as well

Light-Duty Fuel Economy and Acceleration Trends

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

EV charging

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

rider habits

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

Choice factors for trips when passengers considered taking multiple for-hire services options

<table>
<thead>
<tr>
<th>Choice Factor</th>
<th>Percentage</th>
<th>E-dispatch</th>
<th>Yellow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short wait</td>
<td></td>
<td>32</td>
<td>26</td>
</tr>
<tr>
<td>Easy to pay</td>
<td></td>
<td>23</td>
<td>22</td>
</tr>
<tr>
<td>Safety</td>
<td></td>
<td>28</td>
<td>16</td>
</tr>
<tr>
<td>Comfort</td>
<td></td>
<td>27</td>
<td>19</td>
</tr>
<tr>
<td>I was late</td>
<td></td>
<td>23</td>
<td>8</td>
</tr>
<tr>
<td>Fastest</td>
<td></td>
<td>34</td>
<td>31</td>
</tr>
</tbody>
</table>

environmental studies

emissions
> Economist: CO₂ 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
Economist: Global CO₂ emissions may have peaked in 2014

fuel choice

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

freight modes

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

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

freight modes

DOT RITA: Different freight modes used across country

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

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

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

topics
energy markets
automotive markets
technologies studies
environmental studies
consumers/opinion surveys
policy studies
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)

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%).

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)

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

travel patterns

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

travel patterns

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

travel patterns

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

Changes in Highway Use and Lane-Miles

Index (1980=100)

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

topics
energy markets
automotive markets
technologies studies
environmental studies
consumers/opinion surveys

6 policy studies

qar

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

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

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

CO₂ 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.

summary

15.4

4Q 2015