



Fueling the future

**Preparing the downstream
oil and gas industry for the
mobility revolution**

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Introduction

The increasing adoption of electric vehicles will ultimately have a profound impact on oil refining, retail fuel, and lubricants demand. Oil and gas companies know this. And yet, it's common to underestimate how the confluence of multiple forces outside the oil and gas industry will increase the velocity and impact of the switch to the electric from the internal combustion engine.

Specifically, we believe the introduction of autonomous vehicles, coupled with Mobility as a Service, will combine with additional societal and technology trends to drive a more precipitous disruption than typically expected—one which is likely to pull electric vehicles into the market and shift the composition of the fleet much quicker than currently anticipated.

These external forces will usher in a fundamentally new transportation paradigm and begin to disrupt

downstream companies in the coming years. What currently seems like a slow-moving threat may have more near-term business implications.

Downstream oil companies may struggle with preparing for a disruption with an unclear, yet potentially accelerated, timeline. An approach to transformation that takes measured steps and addresses hotspots first can strike the balance between protecting today's business and building tomorrow's.

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Andy, the strategy leader for KPMG Energy and Natural Resources, has more than 35 years of sector experience. He has led transformational programs precipitated by disruption, including new technologies and innovation, supply and demand shocks, regulation, and new forms of competition. Andy also is an author and speaker on multiple disruptive issues and topics facing the energy industry. Most recently, he led panel discussions on the future of mobility and energy value chain implications at the Los Angeles and Detroit Auto Shows, and he presented at the American Fuel & Petrochemical Manufacturers annual meeting and KPMG Global Energy Conference.



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Disruption on the fast track

A new set of forces is on the horizon, beyond the confines of the energy industry. These forces in isolation would likely not impact oil and gas companies for some time, but when layered upon one another, have a compounding effect that is laying the groundwork for disruptive change.

The downstream industry is at risk of being overly complacent about fuels demand destruction. The common belief is that oil demand from China, India, and emerging markets will offset the impact of hybrid and electric cars and increasing fuel economy standards; OPEC recently raised its forecast for demand through 2040.

However, there's a hint at trouble; the same OPEC report also noted that faster penetration of electric cars has the potential to reduce these demand outlooks.¹ More recently, equity markets "have spoken." Shale oil producers were compelled to limit growth spending within current cash flows, focusing on returns versus production growth, or face reduced stock prices as a repercussion. Industry analysts cite concerns over oil demand destruction as the rationale for favoring returns now versus production growth.

While the industry is well attuned to monitoring the adoption of electric vehicles (EVs), by stepping back to

see a broader picture, a fundamentally new mobility paradigm comes into view. EVs, autonomous vehicles (AVs), shared economy business models such as Mobility as a Service (MaaS), and advanced technologies are combining with societal shifts such as urbanization and the influence of Millennial employee and consumer values, including sustainability. Together, these technological and social changes represent rapidly developing trends and forces that could lead to the faster EV penetration OPEC mentioned.

The total number of EVs on the road compared to internal combustion engines (ICE) is still relatively small, and the barriers to rapid expansion are well known. Limited battery range, high installed battery cost, long "refueling" times, and sparse recharging infrastructure are just a few. Today, ICE-equipped cars have significant economic, refueling, and other driving experience advantages. Hence, despite various incentives,

EVs are struggling to meaningfully "push" their way into the U.S. market based on economic and other experience factors alone.

Yet, the combination of EVs and other innovations leading to autonomous vehicles, coupled with the social forces cited, will create a "pull" for accelerated vehicle electrification. In particular, we envision that the most significant near-term disruption will occur in major U.S. metropolitan areas where these forces are concentrated.

Just how quickly and widely EVs will penetrate the market remains to be seen. Regardless, wherever we end up on the scale between modest disruption on one end and massive upheaval on the other, the oil and gas industry still needs to prepare for impact. Here are a few of the developments that downstream companies should keep an eye on.

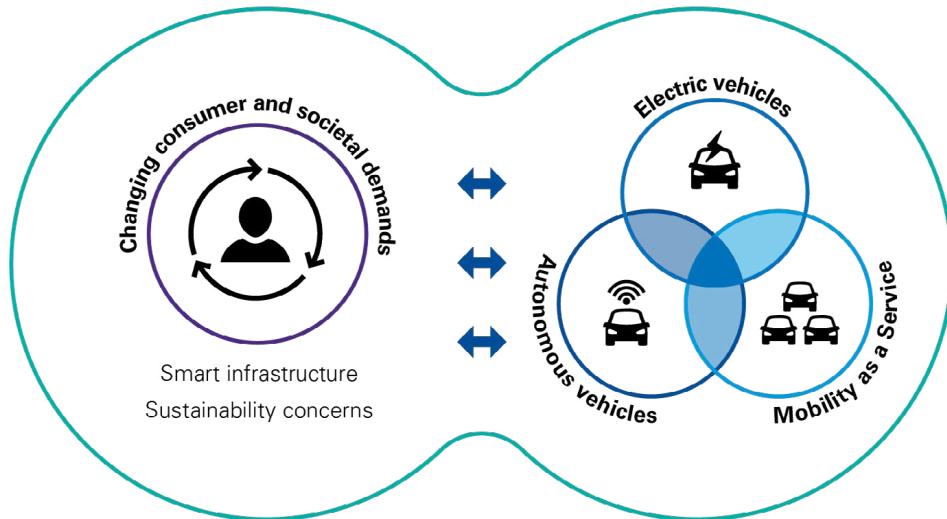
¹"Opec sees more global oil demand despite electric cars," Financial Times, November 7, 2017.

Electric vehicle adoption in the United States remains tepid, for now.

Outside of the United States, governments are pushing EV adoption by regulatory fiat. Norway, the United Kingdom and France are among the countries with set dates for firm bans on pure ICE-powered vehicles in the coming decades, while others like India and China are anticipated to follow. In tandem, automakers are committing to boosting EV production and/or ending ICE-only production, as Volvo announced it would do as soon as 2019.

In the United States, without much government pressure outside of California, EVs remain a niche market accounting for less than 1 percent of U.S. auto sales. This generally market-driven EV growth is currently slow going, but several trends and forces at work will boost the pace.

A mobility paradigm shift is fueling faster-than-anticipated EV uptake



A generational shift will underpin consumer demand for EV, AV, and MaaS.

It comes as no surprise that younger generations Y (a.k.a. Millennials) and Z are more willing to use self-driving technology than Gen X and the Boomers, according to the J.D. Power 2017 U.S. Tech Choice Study.² In fact, not only is Generation Z interested in the new technology, but half said they are also interested in mobility sharing or co-ownership, 56% are interested

in unmanned mobility, and the same number are interested in mobility on demand.

At the same time, Y and Z are known as "green generations" for a reason. They are loyal to and willing to pay more for brands that embrace sustainability, making them enthusiastic customers for electric

AV MaaS providers.³ It's particularly important to note that generations Y and Z are the largest living generations in the United States, and it's these two massive population groups who will exercise significant buying power as increasingly autonomous and electric vehicles come to market and mobility services expand.

Millennials, who are becoming the largest component of the workforce and a major component of urbanization, demonstrate affinity for sustainable MaaS

76%
Expressed genuine interest in the environment

69%
Believe it's important for brands to be ecologically conscious



64%
Say there is solid evidence the earth is warming

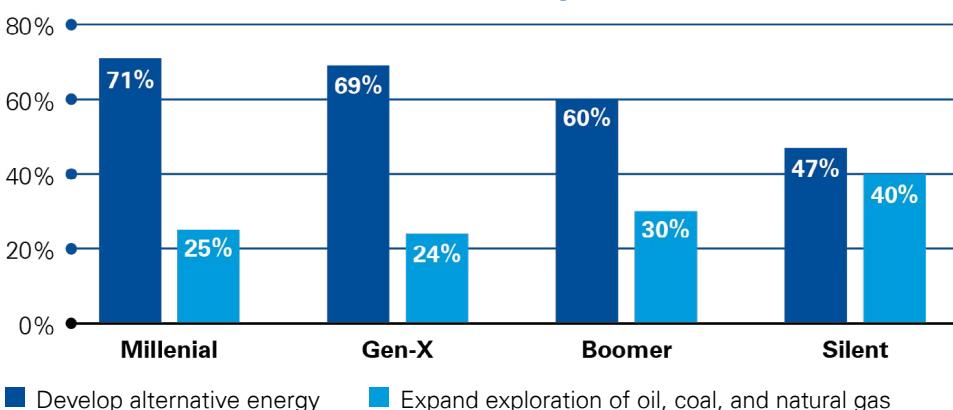
78%
Think owning a car is difficult due to high costs of gas and maintenance

64%
Would be willing to pay more if they knew some money was going toward an environmental cause

66 percent of global consumers say they're willing to pay more for sustainable brands—up 55 percent from 2014.

73 percent of global millennials are willing to pay more for sustainable offerings—up from 50 percent in 2014

Survey: What should America's energy policy be?



Source: Nielson Global Survey of Corporate Social Responsibility and Sustainability 2015

Source: Adage, TheCityFix, Pew

²U.S. Tech Choice Study, J.D. Power, April 2017.

³"The sustainability imperative: New insights on consumer expectations," Nielsen, October 2015.

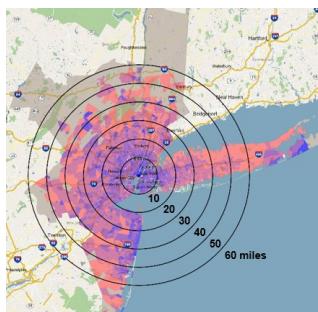
Miles traveled will soar.

Even as car ownership declines, we believe AV and MaaS usage will stretch vehicle use at both ends of the age spectrum. According to our research and analysis, lower-cost AVs and the widening availability of mobility services will tap latent demand and generate miles otherwise not traveled under the current paradigm.

Working parents will grow comfortable sending kids off to soccer practice and piano lessons in shared transportation or, eventually, in personally owned driverless vehicles. Meanwhile, future retirees will enjoy independent mobility currently hampered by physical limitations.

For a hint at the potential for increased MaaS miles, look at Uber's statistics today. According to the company, 75% of the U.S. population lives in a county with access to its service, with wait times of less than seven minutes.⁴

Dense Uber networks have formed in and around cities across the nation

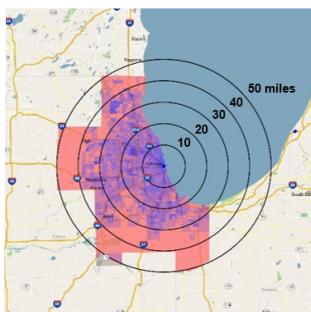


New York City

Type A: Dense urban center, large suburban metro area, high public transit usage

Average wait for closest Uber: 6:09 minutes

n = 27,908



Chicago

Type B: Significant urban center, sprawling suburban metro area, medium public transit usage

Average wait for closest Uber: 6:43 minutes

n = 12,928



Los Angeles

Type C: Unclear urban center, vast suburban metro area, low public transit usage

Average wait for closest Uber: 5:24 minutes

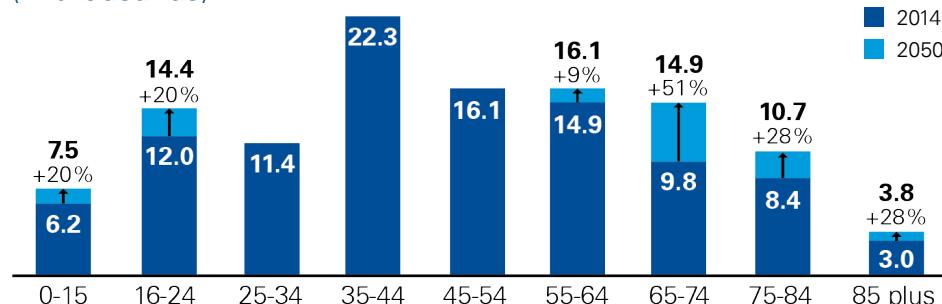
n = 18,107

Minutes wait: Less than 3:00 3:00 – 5:00 5:00 – 7:00 More than 10:00

Notes: (1) Census tracts were sampled a minimum of four times. Those that returned an available Uber at least once were defined as having regular Uber service.

(2) Average wait time calculation is population weighted and only includes areas where Uber is available. Source: KPMG analysis of SafeGraph cellphone location data

Distributions of U.S. personal miles traveled (PMT) per capita by age group 2014–2050 (in thousands)



Safe independence for the kids

Note: (a) Discounted 25 percent from U.S. Bureau of Transportation Statistics (BTS) total Vehicle-miles traveled (VMT) for 1995, 2001, 2009, 2014 (assumed to be commercial miles), (b) multiplied by NHTS occupancy rates applied 2009 rate to 2014 numbers. Source: U.S. BTS data, NHTS data, U.S. Census data, KPMG analysis

⁴“Lyft extends service throughout 32 states,” USA Today, August 31, 2017.

Parents can be everywhere at the same time

82 percent would want mobility options for kids, according to a focus group

“I do not have to take keys away from dad”

79 percent of people would want mobility options for seniors

Autonomous driving is already here, and governments are preparing for AVs.

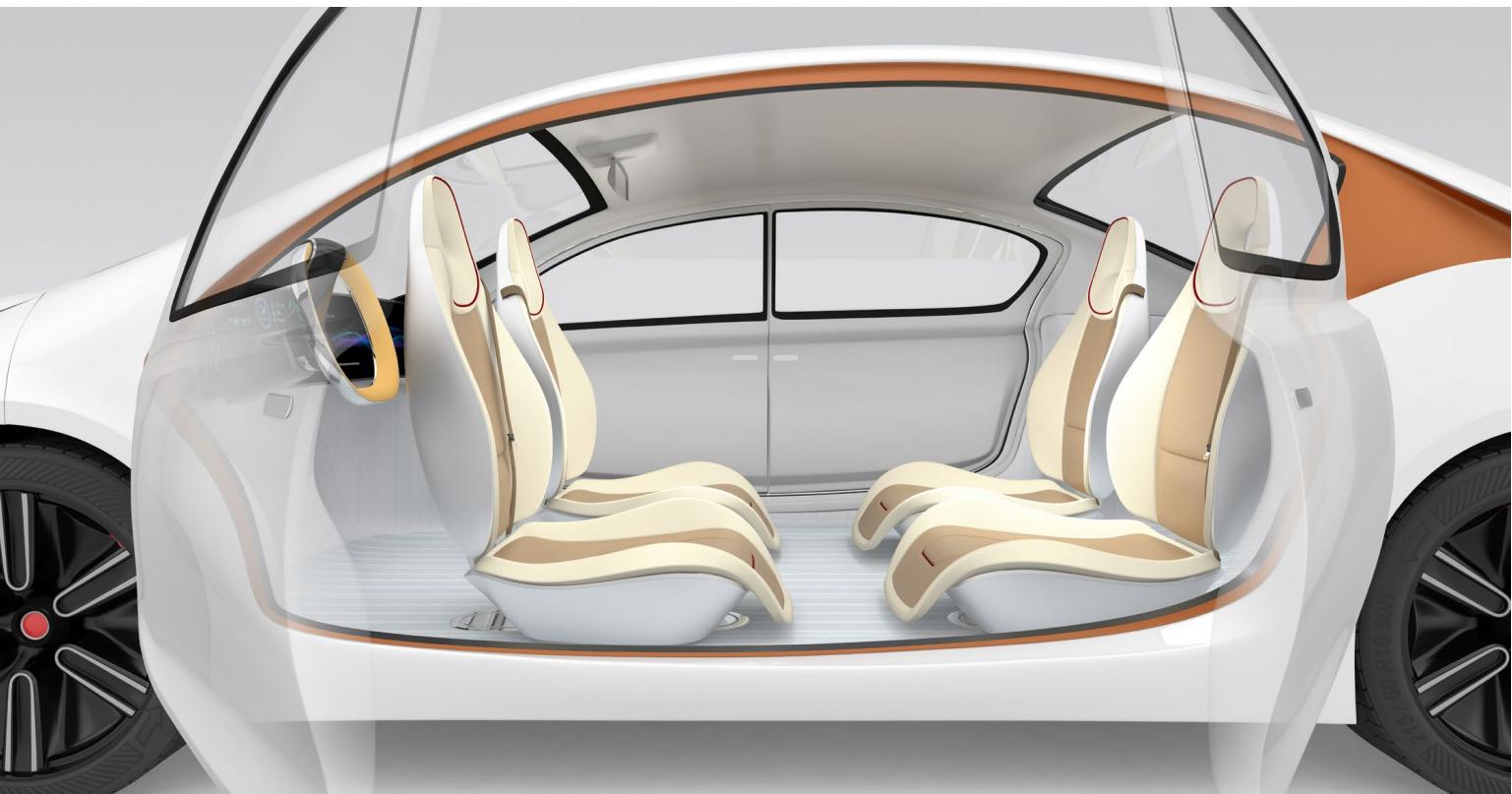
In recent years, deep learning (an advanced form of artificial intelligence) has propelled autonomous driving from fantasy to reality. It was once thought that large-scale infrastructure would be required before deploying AVs on any mass scale, yet as this paper goes to print, manufacturers are building vehicles that are capable of navigating the streets with their own embedded technology alone. Today's drivers are already benefiting from many of the same technologies that will guide fully autonomous vehicles, including driving assistance and collision protection.

In fact, consumer caution about AVs may actually be misunderstanding.

The J.D. Power study highlighted a dichotomy in consumer sentiment between increased interest in what was described as "new technologies" but also increased skepticism about the same "automated technology."

As KPMG's own research suggests, drivers are increasingly willing to climb into fully autonomous vehicles for a ride once they clearly understand risk versus reward, get excited about the technology, and can imagine the lifestyle benefits.⁵ Furthermore, for many, the compelling economics of ride sharing (which will increasingly take place in autonomous vehicles) versus personal car ownership could tilt the scale.

Entire legal, regulatory and insurance ecosystems will need to change to make way for AVs. Government must reimagine infrastructure finance once funding from gasoline taxes begins to evaporate, and it will likely take an act of Congress to address the redefinition of automobile licensing, liability and insurance in an autonomous world.⁶ However, policy fixes are in the works and government is increasingly focused on supporting AV innovation. The federal government has taken steps; the National Highway Traffic Safety Administration has developed a Federal Automated Vehicles Policy, and the U.S. Transportation Department identified 10 pilot sites to test AV technologies.⁷



⁵"Self-Driving Cars: Are We Ready?" KPMG, 2013.

⁶ "Beyond Speculation: Automated Vehicles and Public Policy," The Eno Center for Transportation, May 2017.

⁷"Cities Rush to Build Infrastructure—for Self-Driving Cars," The Wall Street Journal, November 9, 2017.

MaaS is taking hold, especially in and around population centers.

In the burgeoning sharing economy, excess capacity—be it in cars, houses, clothing, or another commodity—is increasingly accessible at the touch of a smartphone app from companies such as Uber and Lyft, Airbnb, and Rent the Runway.

The penetration of transportation-on-demand companies such as Uber demonstrates that MaaS has already made a huge impact in urban settings. With transportation on demand, families may decide they need only one car, or none at all.

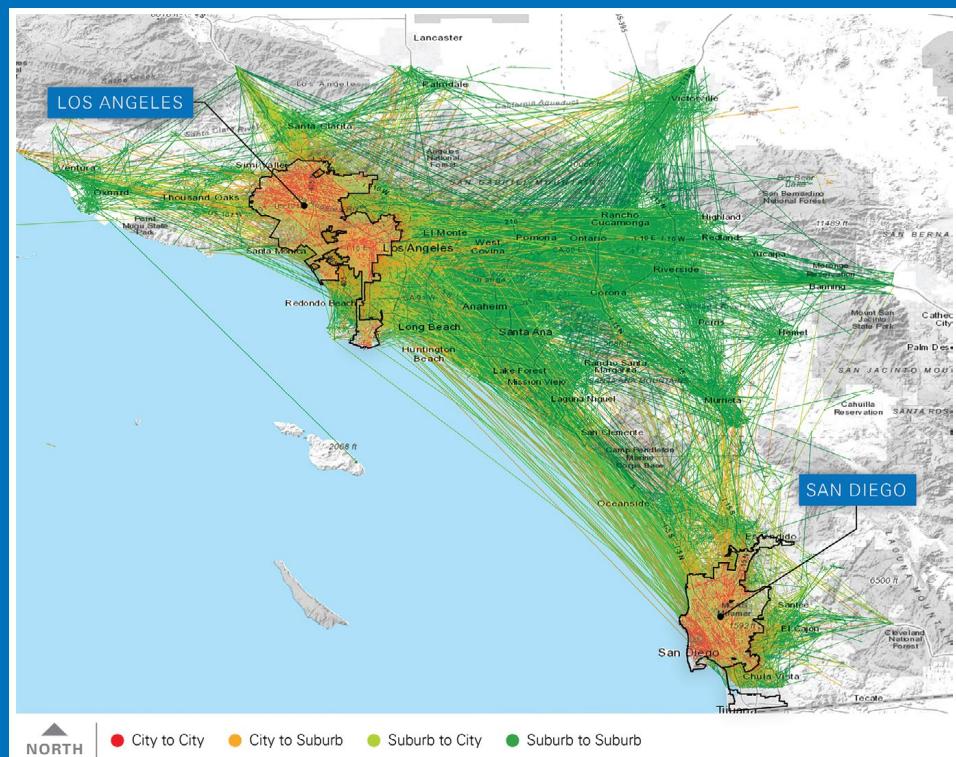
Islands of autonomy

In its latest white paper on disruption in the automotive industry, KPMG discusses how autonomous vehicles coupled with mobility services will create a new transportation mode. However, the takeover will occur in individual metropolitan markets first, creating unique “islands of autonomy.”

One such “island” is Los Angeles-San Diego where travelers experience very long-duration (even if not long-distance) commutes. As such, that market might support autonomous vehicles with space for work or entertainment systems for leisure for the 90-minute-plus trips. As we discuss in this paper, several trends indicate that these AVs will increasingly be electric powered.



Los Angeles-San Diego “A binary star megaregion”



Read more about the emergence of AVs in cities around the world at [this link](#).

<http://www.kpmg-institutes.com/institutes/manufacturing-institute/articles/2017/11/islands-of-autonomy.html>

City and state investment in smart infrastructure can help drive AV and MaaS adoption—and the tilt toward EVs.

More local governments large and small are pursuing initiatives to create smart ecosystems, enabled by sensors and Internet of Things (IoT) connectivity, to support mobility services, environmental sustainability, and other efforts to improve the lives of their citizens.

Today, those sensors might be used to control street lights, aid first responders or monitor traffic. Once in place and bolstered by IoT, data analytics and high-powered cloud computing, this same sensor infrastructure will be used to improve the safety and navigation of AVs, accelerating their use, while supporting MaaS fleet drivers with improved congestion and parking control.

For example, KPMG teamed with a predominant OEM for a major European city to evaluate diesel versus electric buses. The analysis incorporated societal costs such as emissions and noise into classic life cycle total cost of ownership analysis. This "TrueCost" approach solidified the choice of electric over diesel buses for public transit.

"Smart Cities" architects are utilizing tools to incorporate societal costs into Total Cost of Ownership



Conventional versus true total cost of ownership (major European city – KPMG/OEM assessment)

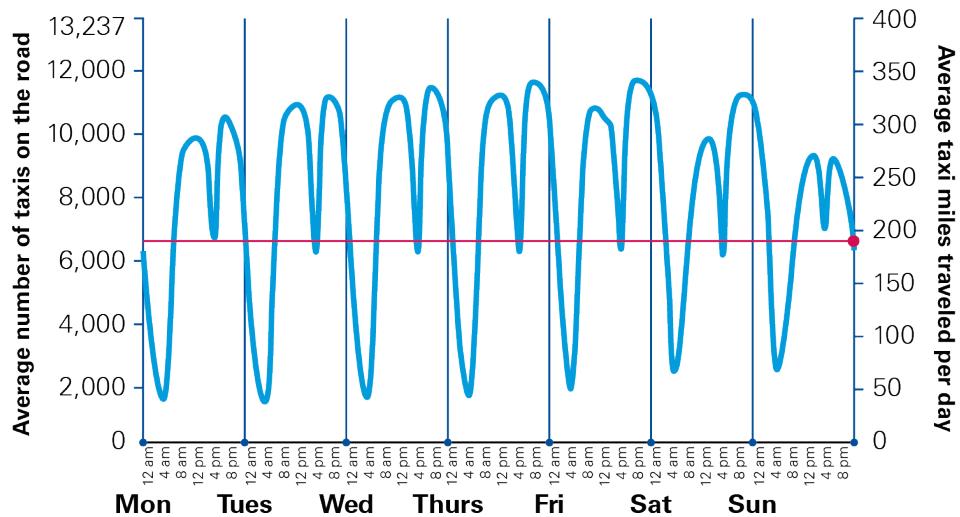
TrueTCO for diesel bus		TrueTCO for electric bus	
ConventionalTCO	Socio-economic	ConventionalTCO	Socio-economic
	Environmental		Environmental
	Admin & garage		Admin & garage
	Fuel/Energy		Fuel/Energy
	Driver		Driver
	Lease		Lease
Impact		Cost U.S. \$	
Greenhouse gasses		\$134 per ton of CO ₂	
Local pollution		Ranges according to type: NO ₂ , VOCs, S02	
Noise		Varies according to level of noise indoors and outdoors (i.e. 75 decibels = U.S. \$2500 per person per year)	
Travel times		A value of time of approx. \$6.50/hour per passenger wait time	

Urban MaaS fleets will become increasingly autonomous and electric.

One of the key issues holding back EV adoption is range anxiety, but that matters less in the city. Today's EVs have enough range to make them attractive to MaaS fleet operators in urban areas like New York City, where the average taxi drives 190 miles per day and the vast majority of trips are less than 12 miles each.⁸ EV recharging may not be a concern either, as MaaS taxi fleets can recharge during their off-peak, overnight hours or between shifts.

As MaaS expands, fleet operators in major cities could look to buy up the new AV cars as they roll off the production line. When electrified, these urban AV workhorses can offer a lower cost per mile traveled compared to ICE vehicles. And, since MaaS companies will look to meet government (including smart city) sustainability and emissions goals as well as cater to the green consumer, they could have a bias toward EVs.

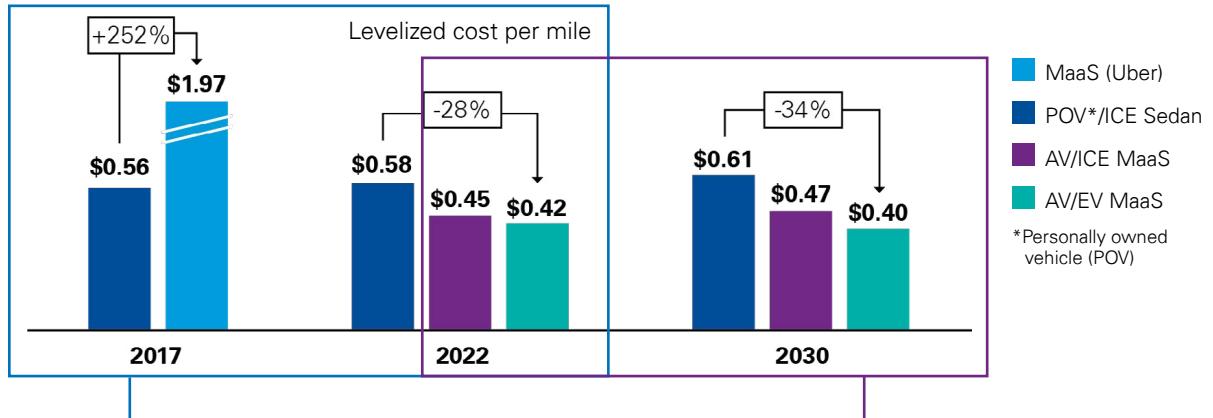
Taxi utilization pattern alleviates refueling concerns



Source: NYC TLC TPEP Trip-sheet data, 2012

⁸2014 Taxicab Factbook, http://www.nyc.gov/html/tlc/downloads/pdf/2014_taxicab_fact_book.pdf

Changing MaaS fleet economics drive the mobility tipping point



The battle of the ownership models: The first transition

Today, the leveled cost per mile for personal vehicle ownership (POV) is significantly lower than for ride-hailing services (MaaS). Yet, companies such as Uber and Lyft are attracting a large and growing number of customers. Why?

Younger generations are less interested in making a significant upfront investment to buy and own underutilized, depreciating assets. With no car, they eliminate annual payments for insurance, registration, maintenance, etc., and they don't need to pay for parking. Instead, they access reliable, on-demand ride services within 5-15 minutes.

As those who hold on to their vehicles drive less, their low annual miles driven significantly increases their costs per mile; MaaS becomes more appealing.

While at this point the shift to MaaS is still powertrain agnostic, autonomous vehicle technology (AV) will begin to eliminate MaaS driver cost, making the economics of AV MaaS more compelling.

Leveled Cost per Mile (cost to a consumer) Assumptions:

Note: (a) Average Uber cost per mile for 5 min to 20 min trip in top 10 largest cities in U.S in 2015 (b) AV MaaS and POV assume 5 year TCO (MaaS - 70k miles/year, POV - 15k miles/year) (c) AV/EV vehicle used for comparison is 2018 Chevrolet Bolt, AV/ICE is 2018 Prius (d) 2.2% historical price growth CAGR applied to ICE sale price forecast (e) 50% drop in EV battery price between 2017-2025 (from \$250/kWh to \$125/kWh), range = 240miles/60kWh Battery (f) AV MaaS includes 30% operator profit margin (g) Fuel Assumptions = \$3.00/gal ICE (10 year national historical average), \$0.12/kWh EV

Sources: (1) Uber (2) Business Insider (3) AAA (4) Kelley Blue Book (5) KPMG Analysis

The battle of the powertrains: The second transition

In the future, AVs will shift the cost advantage to favor MaaS. With MaaS established as the advantaged model, further advances in electric vehicle (EV) technology will make the electric powertrain a continually greater challenge to the internal combustion engine (ICE).

Lower EV maintenance and fuel costs will further increase AV MaaS operating cost advantages. Meanwhile, EV battery costs will continue to decline, per the DOE R&D Roadmap.

Finally, smart government focus on sustainability and AV-friendly infrastructure, as well as generational affinity for green transportation, will continue to support the growth of AV EV MaaS fleets in urban settings.

As miles traveled become increasingly battery powered and not gas powered, autonomous MaaS fleets will drive gasoline displacement on the urban streets that 80 percent of the U.S. population calls home.⁹ The remaining issue is how far and how fast does adoption of electrified AVs move beyond urban areas?

⁹United States Census 2010

The push and pull of electric, autonomous, and MaaS fleet adoption

In sum, right now there's just a gentle push toward greater EV adoption in the United States relative to the rest of the world, limited to a few states with strong emissions reduction policy mandates.

EVs still face the challenges of higher costs, lack of charging infrastructure and underdeveloped battery technology, feeding an economic and convenience disparity that favors ICE. There's little pressure for environmental regulation and subsidies that favor EVs, with much stronger mandates coming from European regulators than their U.S. counterparts. In other words, the U.S. remains primarily (and increasingly uniquely, compared to other OECD nations) market versus policy driven.

Fleet turnover, once a key data point used by the oil and gas industry to anticipate demand, will matter less as personal car miles are displaced over time by AV EV MaaS fleet miles. ICE-drive train cars may remain in the fleet, but be driven less frequently.

However, as the trends we outlined take hold and a fundamentally new transportation paradigm is established, we believe the marketplace will flip, and consumers will not just be pushed by subsidies and regulatory efforts but pulled toward EV adoption.

Our estimates indicate this flip will occur faster in the largest U.S. cities. Beyond urban centers, we anticipate adoption of AV EV MaaS fleets in suburbs, just as ride sharing has penetrated these areas.

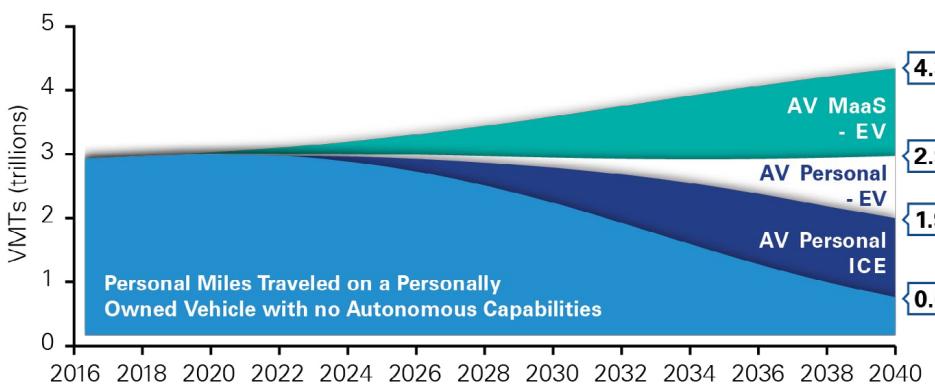
We also foresee further EV penetration into the personal vehicle market as current barriers to adoption such as the lack of a charging infrastructure fall away; battery and EV costs decline through next-generation technologies such as solid-state lithium-ion; and fleet owner interest and Millennial and other societal preferences for sustainable mobility begin to influence the market, ushering in a second round of significant changes impacting the oil and gas industry.*

*In an upcoming paper, we address how these barriers will affect further EV adoption, as well as how the power and utilities sector will be impacted.

Shift from “Push” to “Pull” forces driving EV adoption

	Push	Parity	Pull
Overall adoption	Limited to luxury segment; otherwise uneconomic versus ICE	AV MaaS fleets adopt EV in selected major metro areas; EVs advantaged in mid-market and parity in mass market	Widespread AV EV MaaS fleet adoption in cities and dense suburbs; rapid extension of personally owned EVs
Charging infrastructure	Limited DC charging available	Home and office charging options proliferate	Supplemental on-the-road fast-charging infrastructure alleviates range anxiety issues
Smart city and electrification	Multiple cities planning for digital infrastructure to address safety, accessibility, and sustainability	Proliferation of sensors and IoT; leveraged to enhance mobility Fleet mobility choices incorporate sustainability	Smart infrastructure and sustainability convergence underpin continued electrification expansion
Battery technology and range	Manufacturing scale, other learning curve, Incremental changes to battery materials drive close to ICE cost parity	New chemistries increase power density and push battery cost to \$100 per kWh (at parity or better)	Battery cost and range issues no longer a factor – new chemistries at 4x energy density and half the cost
Regulatory	Direct EV subsidy Distributed resource, demand response, power pricing pilots in CA and select other areas	Make ready infrastructure and other utility investments incorporated in allowable rates	EVs integrated into utility infrastructures as viable distributed resource providing grid services
Oil market	Lower for longer oil prices Limited liquid fuels demand destruction	Lower for longer oil prices Flattening gasoline demand due to hybrid, other ICE improvements, EV penetration	Lower forever oil prices Significant gasoline and increasing diesel fuel demand destruction
	2015–2020	2020–2030	2030+

Displacement forces will soon be material



- External ecosystems are evolving quickly, with near-daily developments
- OEMs and digital disruptors are already beginning to combine forces
- Demand for sustainable mobility is gaining momentum
- The convergence of these forces has the potential to materially impact transport mix in select regions or markets

The new dynamics in downstream: The clockspeed dilemma

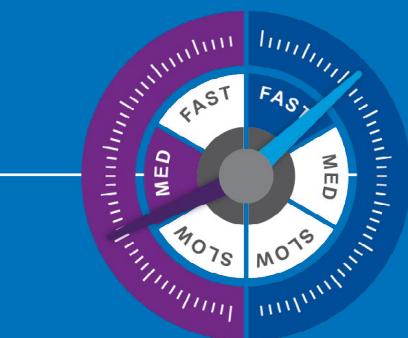
For companies to thrive in this new environment, they must solve what we call “the clockspeed dilemma.” That is, the challenge of seeing, adapting to, and keeping pace with faster or multiple rates of innovation imposed by sometimes seemingly external ecosystems.

Downstream companies, like other capital intensive industries, are slowed down by a legacy clockspeed linked to new product development costs, competitive dynamics, and brand development investment. But new, digital competitors such as Uber and Apple are crossing competitive ecosystems and moving at faster and often multiple clockspeeds.

Combined with changing social demographics and attitudes, competitors and forces outside the fuels retail industry are changing the level and type of demand for transportation. In some ways, this is threatening fuels demand, yet it is also unlocking latent transportation demand, potentially creating entirely new choice and usage segments offering the potential for new value and growth opportunities.

Executives must reconcile these multiple forces and paces of change driven by social and digital trends, including mobility services expansion, electric vehicle proliferation, and vehicle autonomy, and how their combined effects may bring change and opportunity across various aspects of today's fuels retail business and operating models.

For more information, see **“The clockspeed dilemma: What does it mean for automotive innovation.”**



Competing “Clockspeeds”

Incumbent

Movies
Music
Hospitality
Transport

Newcomer

Netflix
Apple
Airbnb
Uber

Incumbents must now look beyond traditional sector boundaries

Know your exposure

Disruption to the U.S. oil and gas industry won't happen everywhere, or overnight. But change is happening in pockets—right now. By understanding where to anticipate impact first, oil and gas companies can take a measured approach to transformation.

The conventional thinking about the impact of technology and regulation on oil demand may be too conservative.

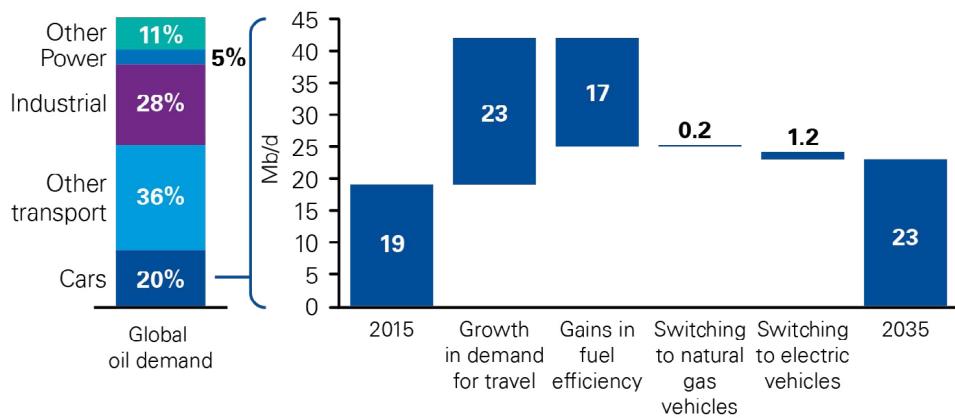
On one hand, internal combustion engines may stay the preferred drivetrain globally for some time, helping to sustain oil demand worldwide. Cars account for just an estimated 20 percent of global oil demand, and most forecasts indicate increased global net growth in demand for cars, particularly from developing nations, while the infrastructure challenges to EV uptake remain.

However, individual companies face more or less exposure depending on their footprints.

In urban centers where EV adoption rates are likely higher, localized impacts on fuel displacement may become significant, creating a disproportionate impact on the liquid fuels value chain. And past industry experience has demonstrated that the impact of supply or demand changes at the margin have disproportionate impact on retail netbacks. As Bloomberg recently articulated, EVs don't have to destroy the fuels market to disrupt it.

By 2040, an estimated 530 million EVs, or 34 percent of the cars on the road, will displace up to 8 million barrels of transportation fuel per day¹⁰ with the U.S. accounting for 15-20 percent of that. Netback reductions will then flow up the value chain to refining, and EV penetration displacing lubricants demand as well.

Forecast for changes in global liquids demand from cars 2015–2035^(a)

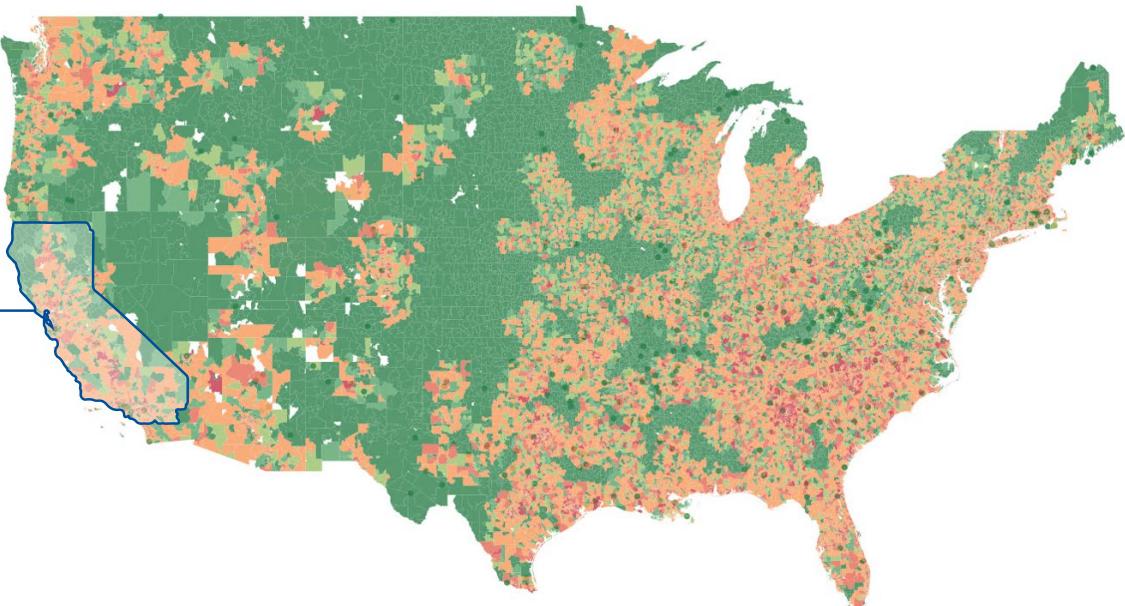


Source: ^(a) BP Energy Outlook 2017; BP, "Back to the future: electric vehicles and oil demand"

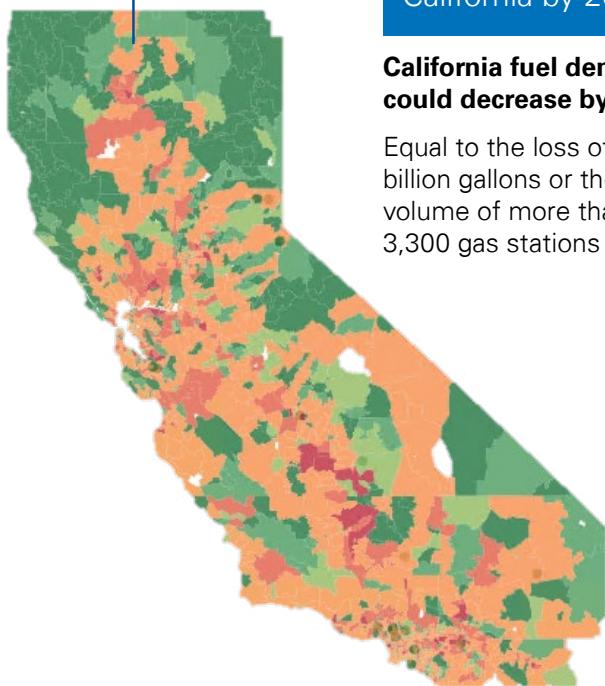
When companies understand their exposure, they can begin to determine *what* kinds of actions to take—buy, build, or partner in new businesses—as well as *where* to act first and ultimately *when* to take action.

¹⁰Electric Vehicle Outlook, Bloomberg New Energy Finance, 2017.

Potential EV impact on fuel consumption in the United States by zip code



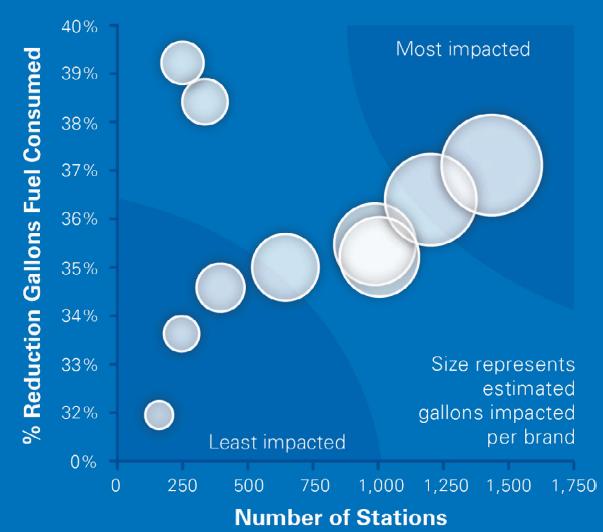
Potential electric vehicle impact on annual fuel consumption in California by 2040...



California fuel demand could decrease by 36%

Equal to the loss of 3.5 billion gallons or the volume of more than 3,300 gas stations

...and how this could impact the top 10 selling brands in California



Potential 2040 gallons fuel lost (at a zip code level)

Minimal to no impact	Less than 500K gallons	Less than 1M gallons
Less than 5M gallons	Less than 10M gallons	More than 10M gallons

Source: KPMG analysis

Take action across the value chain

Once oil and gas companies understand their geographic exposure to the massive trends reshaping their industry, they can begin to craft their plan of action by reviewing their exposure along the value chain to identify how and where these trends will play out.

Note that the value chain is being turned on its head. The industry needs to stop thinking about following a **supply-out model** organized around refining crude and supplying lubricants and fuels to keep up with market demand growth. Increasingly, successful downstream players will need to follow a **consumer demand model** in which companies must work back from customers and anticipate more differentiated needs in terms of driving occasions and implications for vehicle and drive train type. That's why we present the following table with retail fuels on the left-hand side—the customer is, literally and figuratively, in the driver's seat.

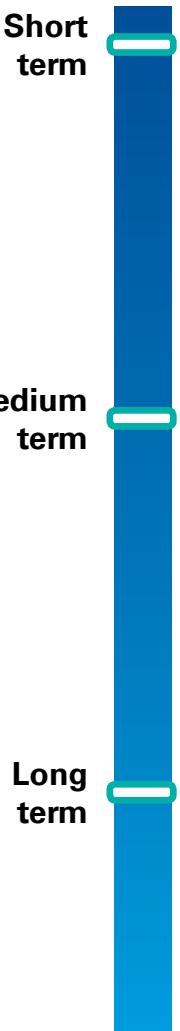
The table also displays the spectrum of preparedness top to bottom, from protecting core businesses in the short term, to investigating alternative business and structural options, and finally shifting core businesses as

necessary for the long term. Ideally, when the trends we identified hit the oil and gas industry in full force, companies will have the right business lines and operational structures to secure their continued business success.

While it's helpful (and less daunting) to think about that change as short-, medium- and long-term, there are no clear lines or timeframes for action, but rather, a fluid transition from core to future businesses.

Further, as companies move down the table toward shifting the core, their requirement for new technology and data and analytics capabilities increases. The ability to create innovative solutions and build a captive customer base through deep understanding of consumer behavior will separate the winners and losers in the new paradigm.

Below, we offer examples of how oil and gas companies can prepare their retail, lubricants, and refining businesses for change by positioning themselves for new value pools while at the same time repositioning existing assets ahead of disruption.



	Retail	Lubricants	Refining	
Short term	<p>Leverage D&A to optimize margin capture (deeper customer understanding, pricing, ranging, etc.)</p> <p>Explore new capital structures and review portfolios</p>	<p>Investigate adjacencies and positions in non-ICE applications/segments</p> <p>Diversify the value add beyond products to services</p> <p>Expand plug-and-play solutions</p>	<p>Affirm/expand position in less-impacted fuels segments</p> <p>Segment and evaluate "advantaged" versus "at-risk" assets</p> <p>Develop export markets/new value chains</p>	Protect the core
Medium term	<p>Review forecourt fuel mix and pilot new offers (e.g., highway offerings)</p> <p>Investigate new partnerships and ownership models</p>	<p>Create more dynamic lubricant formulation/ process engineering via data feedback loops</p> <p>Drive stickiness through vehicle-based technology</p>	<p>Pilot alternative fuels manufacturing (e.g., biofuels, micro LNG, hydrogen)</p> <p>Re-gear technology and shift molecule mix (e.g., lighter ends, chemicals, etc.)</p>	Investigate optionality
Long term	<p>Pursue digital strategies (e.g., attracting the connected car)</p> <p>Offer B2B/fleet services (e.g., integrated energy offer)</p>	<p>Offer B2B/fleet services</p>		Shift the core



Retail

Retail asset ownership presents particular challenges, especially given the trend among major players to re-integrate into retail sites in light of shrinking demand and a desire to secure offtake. Yet, in a future world of centralized fleets and at-home, overnight electric refueling, the role and value for these sites diminished. Retail owners need to stay agile in order to avoid stranded assets down the road, optimizing the value of their current assets while identifying appropriate sites to acquire or retain that are fit for future refueling patterns.

Use data and analytics to win the fight for customers.

Data and analytics (D&A) is nothing new to the energy sector. For years, retail fuels has been tracking basic information, such as how much gas each station is selling, and how profitable the location is.

However, data not just related to internal operations (volumes, margins, competitor analysis, etc.) but to the retail gasoline customer journey can produce even greater insight, informing everything from the stock that retail locations should keep in their stores, how to price their gas by time of day and relative to the competition, and how successful incentive programs are.

New sources of that data are ready to be mined with existing infrastructure. For example, security cameras already in use at gas stations can capture license plates, and with minimal investment in software, identify repeat

customers and even greater details about them, from home ownership to income. From there, fuels retailers can customize offers, and even sell the data to other retailers.

Take "John," for instance. He usually fills up his tank weekly at the start of his Monday morning commute, after which he buys his coffee at a café down the street. Based on John's and other customer data, the gas retailer introduces gourmet coffee and pastries to its backcourt offering to capture some of that business. It then goes further by pushing promotions for a discounted donut with coffee directly to John on the display screen of the tank where he's filling up. Now not only is John stopping in Mondays for gas, he's back every day for his breakfast. Meanwhile, other non-gas retailers are pushing relevant advertising through that fuel pump display screen to John based on the valuable data they purchased.

By using D&A, retail can not only create an edge over the competition and improve margins, it can begin to build the right mix of products and services for customers who will need less and less gasoline over time as more hybrid and fully electric cars hit the road, and MaaS takes off.

Review capital structures and portfolios to secure control of retail fuel distribution.

The company-owned and -operated or "co-co" model is making a comeback. After years of shifting to dealer-operated and eventually dealer-owned retail locations to reduce capital expenditures and shed liabilities from their books, oil companies are looking at the co-co model as a way to hold on to the retail customer base and gain greater control and insight into their retail operations.

A co-co model allows oil companies direct access to the valuable data required for analysis, greater pricing

control, and command of backcourt sales of non-fuel products. Further, the co-co model can better secure distribution for fuel compared to dealer-based models that allow owners and operators to switch brands. Again, as fewer customers require fuel, or they fill up less often, control over D&A, products, price, and distribution are key to protecting the core business and preparing for change.

How much an oil company's retail footprint matches the electrification heat map will determine the speed at which it must pursue in-depth D&A initiatives and alternative operating structures. However, even for those with a more suburban footprint, it just makes good business sense to introduce operational improvements, rationalize price and footprint, and find ways to better serve a customer who is increasingly in control. Meanwhile, those companies operating in heavily urban areas may even decide to shift their retail footprint outside of the cities, focusing instead on outlying and highway dominance.

Evaluate the fuel mix and pilot new offerings.

We have established that the retail footprint is important to preserve for guaranteed distribution and data. But if consumers are going to be buying gas on a less regular basis, what will these retail gas outlets offer?

Perhaps fuel retailers can build destination experiences. While EV and AV uptake will likely occur in urban areas first, the most creative exploration for retail fuel may appear not in the city but in the country—or more specifically, on the highway.

Individual EV and plug-in hybrid (PHEV) hybrid drivers needs for charging stations will largely coincide with long-distance trips, rather than regular charging that can take place at home

for plug-in vehicles. This marks a significant shift from current behavior characterized by frequent visits to fueling stations.

Furthermore, so-called fast charging is some years away. With a battery that takes half an hour or more to charge, retail fuel outlets should be looking for ways to entertain—and thereby attract—customers who seek quality food, entertainment, and Wi-Fi during charging.

Explore partnerships and ownership models.

One efficient way for oil and gas companies to get into new lines of business would be to partner with—or even buy—companies outside their industry. For example, a franchise partnership can enhance the retail offering with an expanded backcourt with room for shopping, eating, and relaxing. Another partnership could be formed with the regional utility company to supply EV charging at favorable rates.

The challenge will be deciding to pull the trigger on establishing these destinations and partnerships to begin building customer traffic and demand, or waiting for EVs to take off and then create demand. Cost-benefit analysis and pilot programs can produce information even before EVs begin to overtake ICE engines, providing valuable guidance.

Build a business-to-business offering.

As the usage of both mobility services and autonomous vehicles increases, and autonomous MaaS fleets begin to form, a new B2B opportunity opens up to service those self-driving cars en masse. In one model, oil and gas companies with retail locations near urban centers can adapt their current footprint to serve fleet vehicles with integrated offerings such as charging, cleaning, maintenance, and more.

Or, if and when EVs move to car battery swapping—instead of charging, owners replace the battery as needed for a quicker return to the road—these locations can serve as battery warehouses.

These B2B businesses are a jump ball. First movers will have an advantage in a crowded field that could include car dealerships and other retailers in addition to retail fuel. Even if EV adoption remains sluggish, the convergence of trends suggests retail fuels in urban centers could increasingly shift to more of a B2B model serving MaaS companies that will look to squeeze oil and gas companies for economies of scale. The retail footprint will be challenged.

Pursue digital strategies.

Part of serving an AV EV fleet may be monitoring the sensors of these connected cars, and servicing the hardware and software now under the hood.

Finally, retail fuel business transformation comes full circle back to data analytics, as oil and gas companies should think of their data as an asset they can monetize in addition to improving their own operations. Data about customer purchases and behavior has value to other industries that would likely pay for the insights retail gas gathers on a daily basis.



Lubricants

Lubricants may be the part of the value chain most exposed to the changing environment, given the lower maintenance and materials needs of EVs compared to ICE vehicles.

Research adjacent and new businesses.

Many lubricant manufacturers, particularly the most retail consumer-oriented, will need to diversify to counter what's expected to be a drop-off in demand for their traditional products as more electric vehicles hit the road. Geographic footprint may also factor in to the speed of that diversification for those with a heavy presence in population centers.

To start, today's ICE lubricants have room for improvement. Oil companies such as Exxon, BP, and Royal Dutch Shell are working with car manufacturers to develop thinner oils designed to improve ICE fuel economy in the face of regulatory pressure and competition from hybrids and EVs.¹¹ Manufacturers could also begin to explore applications for non-internal combustion engines, which require higher-value lubricants.

At the same time, manufacturers most exposed in the retail market should evaluate and consider pursuing a greater presence in other segments, such as sustainable energy. According to ExxonMobil, the company's synthetic oils and greases are used in more than 40,000 wind turbines globally.

Look to add value beyond the existing products.

BP is one example of an oil and gas company that has committed to creating new lubricants businesses. Castrol innoVentures is tasked with exploring opportunities in smart mobility, products "beyond internal combustion" applications, and intelligent operations through venture capital investment, university partnerships, and other means. Recently announced projects include a joint telematics solution with Zubie, a connected car platform and service provider; as well as investments in Peloton Technology, focused on safety and efficiency in heavy trucking; and GreenSteam, specializing in energy-saving solutions for commercial shipping.

Develop fleet service and other business-to-business offers.

Consider the coming mobility paradigm and the products and services that will be required to serve its players. Nexcel, one of the pioneering ideas developed through innoVentures, is a prime example of adding value with a plug-and-play option. The new technology is

a replaceable, recyclable cartridge that allows an oil change in just 90 seconds. The oil cell that holds the cartridge also contains a microchip and sensors to monitor oil level and quality.¹² Plug-and-play lubricants cartridges are, similar to the replaceable battery, the type of innovation tailor-made for AV fleet maintenance.

There's also an opportunity for lubricant manufacturers to shift from product supplier to service provider by leveraging data gathered from car sensors to improve and even customize lubricant formulation for specific fleets.

This applies to serving businesses outside of automotive, as well. For example, oil and gas companies could play a role in placing, monitoring, and analyzing data from sensors on wind turbines and other renewable energy equipment, and tailoring the lubricant formulation based on that data.

¹¹"Big Oil and Auto Makers Throw a Lifeline to the Combustion Engine," The Wall Street Journal, November 18, 2017.

¹²"How Castrol is reinventing the oil change," January 28, 2016.



Refining

Refining will likely be the last part of the value chain to feel the impact of the trends, but it is destined to feel the most pain. With multibillion-dollar assets at stake, refiners need to act before changes hit their radar; if they are reacting, it's already likely to be too late. The key to strengthening their position is to create advantaged access to crude, and advantaged locations to place refining outputs.

Affirm and expand in less-impacted fuels segments.

For some refiners, that expansion will mean looking abroad. It's no surprise that we anticipate trends impacting ICE vehicle demand will take off more quickly in U.S. urban centers than in Latin American cities, for example, so refiners may explore business to the south.

More, affected oil and gas companies need to begin thinking about owning the entire value chain for export, such as the transportation to take the product to the final customer. In light of lower demand and lower refinery optimization, previously unattractive returns on such assets are looking better. By working backwards from the final destination, or the customer, companies can figure out what they need to own or control to drive the greatest net back.

Segment “advantaged” versus “at-risk” assets to develop export markets and new value chains.

Refineries near the urban areas where we expect these trends to hit first are at greater risk for declining demand. Refineries along the West Coast are prime examples. Cut off as they are from distribution to the interior of the country where fuel demand will decline less rapidly, these refinery owners will need to find outlets for their product, which may very well be Latin America.

Refiners with a heavy footprint in the hot spots we identified also should look for opportunities to build or purchase other assets positioned to serve customers away from those urban areas.

When EP Energy Corporation struggled to find a market for its hard-to-refine crude, it entered into

an agreement with Andeavor (previously Tesoro). The company was able to negotiate for improved economics and create efficiencies through a shorter delivery pipeline, make Andeavor's adaptations to its refinery worth the investment, and strengthen a regional business in an area likely less to be impacted near term.

Re-gear the manufacturing technology to pilot alternative fuels.

Ultimately, as demand for gasoline declines, companies that hold on to their refinery assets will need to repurpose them to manufacture other materials, from bio fuels to chemicals to lighter ends. For example, as part of its Grow the Gulf initiative, ExxonMobil is expanding its chemical plant capacities to turn those molecules into plastic, rubber, and other chemical substances.

Summary

The impact of electric vehicle adoption on gasoline consumption does not appear to be an imminent challenge to downstream players, particularly when viewed through the typical industry supply-demand lens. But focusing on EV trends in isolation risks missing the influence that the collision of autonomous vehicles and other external ecosystems will have on accelerating EV uptake, and the proportion of EV versus ICE miles driven as part of a fundamentally different mobility paradigm.

The near-term question is not just when the change will occur, but where. These forces are initially limited globally, but disruptive locally. The effects will first be felt in urban areas and in the retail fuels section of the value chain before spreading through the lubricants and refinery segments of the chain, and ultimately fanning out geographically.

By anticipating disruption, oil and gas companies have an extraordinary opportunity to deepen and create advantages across the value chain, protecting and ultimately shifting their core businesses and assets to operate successfully in an increasingly electric, autonomous, and digital driving world.



How KPMG can help

The signals for disruptive change in the downstream sector are everywhere. The energy sector must anticipate that change or get caught flat-footed; oil and gas companies can start pre-positioning their business models now.

KPMG helps companies understand the new downstream dynamics and the influence of "external" ecosystems breaking through into the traditional oil and gas sector. We help identify where disruption

will hit first, assist with the review and prioritization of assets, find greater value from and defend core operations, and develop clear yet flexible strategies to evolve into new businesses. We work closely with

oil and gas leaders to anticipate and ultimately adapt to a new era of electric, autonomous vehicles and the sharing economy.



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