



**MOBILITY**  
TRANSFORMATION

EXECUTIVE SUMMARY

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# PEAK CAR OWNERSHIP

THE MARKET OPPORTUNITY OF ELECTRIC AUTOMATED MOBILITY SERVICES

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BY CHARLIE JOHNSON AND JONATHAN WALKER



# AUTHORS & ACKNOWLEDGMENTS

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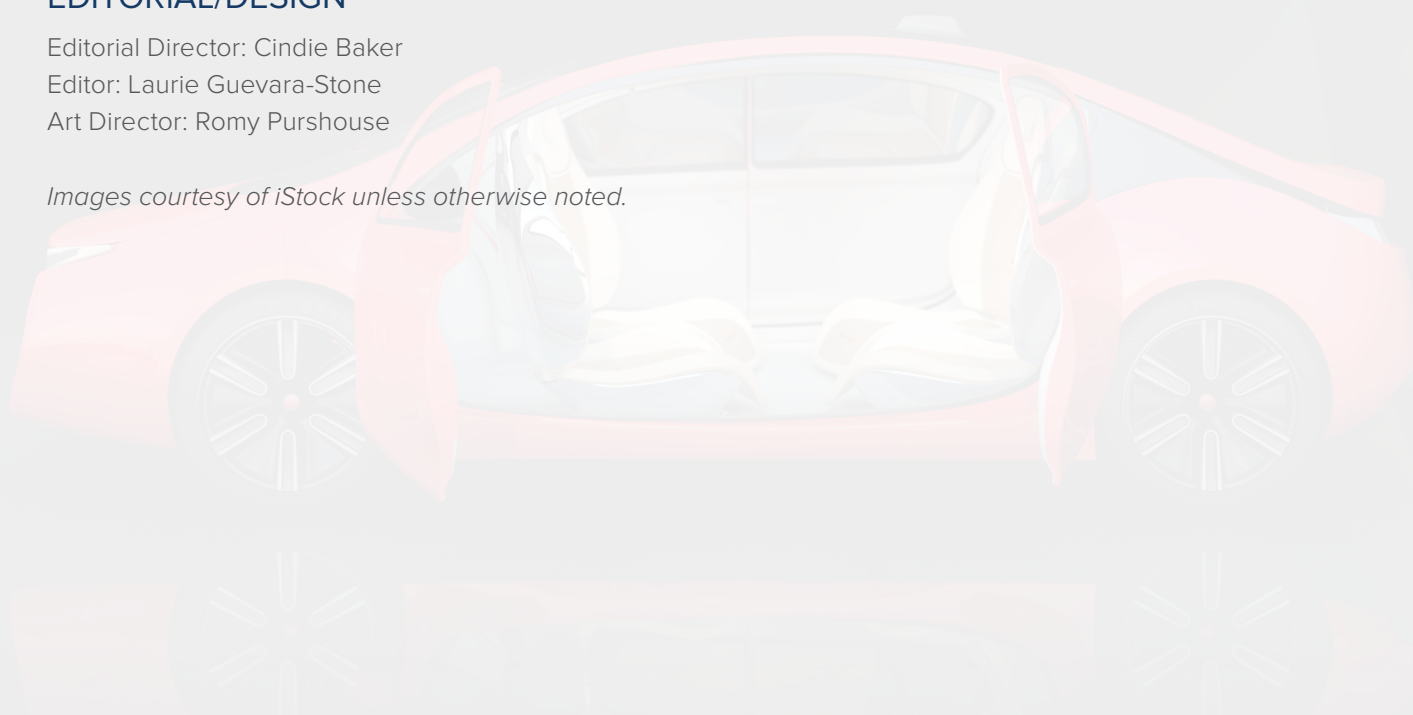
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# ABOUT US

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## ABOUT ROCKY MOUNTAIN INSTITUTE

Rocky Mountain Institute (RMI)—an independent nonprofit founded in 1982—transforms global energy use to create a clean, prosperous, and secure low-carbon future. It engages businesses, communities, institutions, and entrepreneurs to accelerate the adoption of market-based solutions that cost-effectively shift from fossil fuels to efficiency and renewables. In 2014, RMI merged with Carbon War Room (CWR), whose business-led market interventions advance a low-carbon economy. The combined organization has offices in Basalt and Boulder, Colorado; New York City; Washington, D.C.; and Beijing.



## MOBILITY TRANSFORMATION

### ABOUT MOBILITY TRANSFORMATION

Rocky Mountain Institute's Mobility Transformation program brings together public and private stakeholders to codevelop and implement shared, electrified, and eventually autonomous mobility solutions. Working with U.S. cities, it leverages emerging technologies and new business models to reduce congestion, decrease costs, increase convenience, enhance safety, curb emissions, and ensure economic growth.

Please visit <http://www.rmi.org/mobility> for more information.



## MOBILITY TRANSFORMATION



*The rise of automated mobility services could be one of the most interesting and complex disruptions of the modern era.*





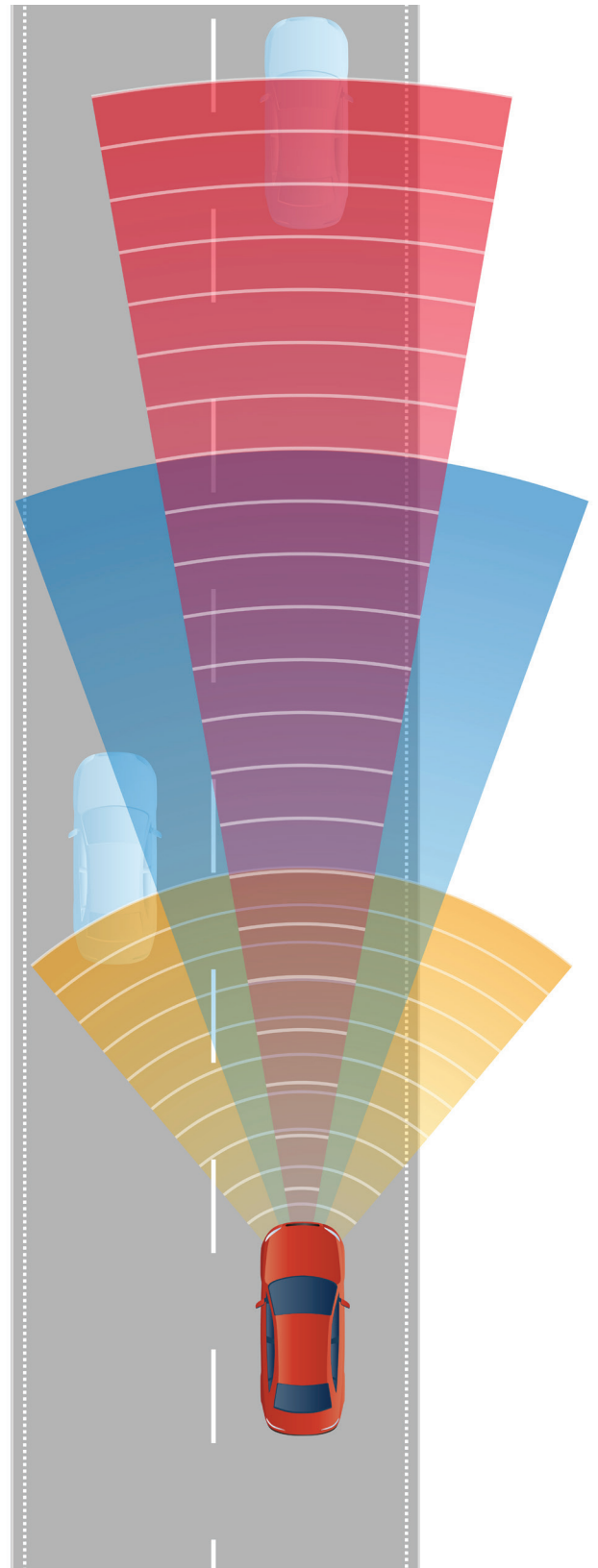
# INTRODUCTION

Personal vehicles have dominated the U.S. mobility system for nearly 100 years. But we are now in the formative stages of a powerful confluence of cultural, technological, and societal forces. It is possible that a new mobility system will emerge in the next few years that is superior to our existing system in almost every way. This report provides guidance on what to expect so that stakeholders can prepare today.

Analysis by leading organizations and experts indicates the technical, logistical, and economic plausibility of a future where most mobility needs are met by mobility services, enabled by autonomous driving technology, and powered by electric powertrains. This future system has the potential to reduce costs by over \$1 trillion, reduce CO<sub>2</sub> emissions by a gigatonne, and save tens of thousands of lives per year in the U.S. alone.

With so many advantages, hundreds of billions of dollars could shift away from personal vehicle products and services to mobility service providers like transportation network companies (TNCs), technology companies, and the nimble automakers that are able to pivot. What is unclear is the rate and scope at which the disruption could occur and the impact it will have on determining winners and losers, both of which are highly dependent on the decisions made today by stakeholders (financial institutions, automakers, new entrants, electric utilities, governments, etc.).

This report provides strategic decision makers with potential market sizes and plausible rates of mobility service proliferation that could occur under reasonable circumstances. The report is the product of analysis to determine key economic tipping points combined with relevant consumer-adoption data and trends to estimate market sizes, growth rates, and impacts on demand for personal vehicles, gasoline, electricity, and CO<sub>2</sub> emissions. The results suggest that key stakeholders must shift their business models and policies to benefit from this mobility transformation.

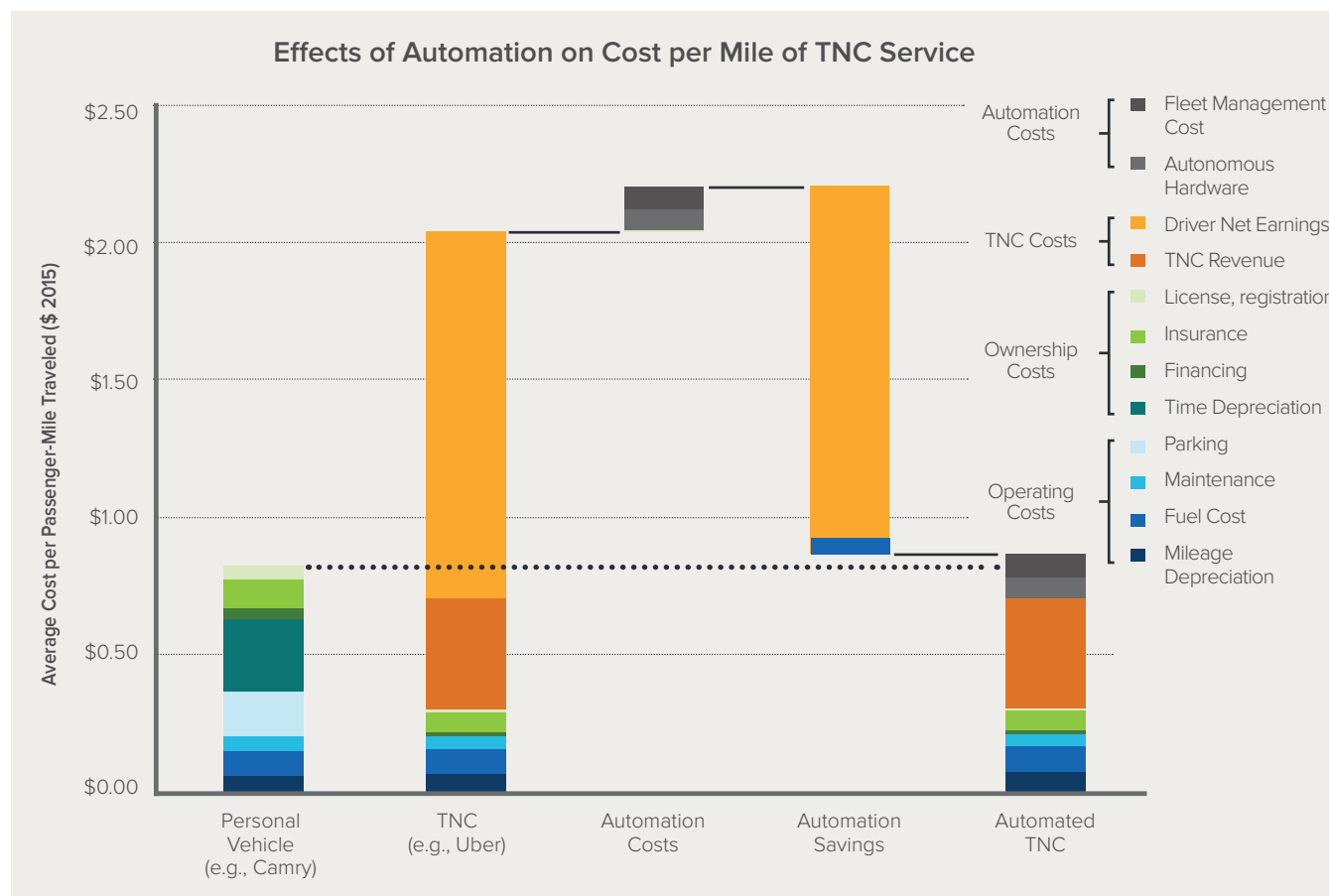


# KEY FINDINGS

## 1. By 2018, solely using autonomous taxis for transportation could cost the same as owning and operating a car.

**FIGURE 1:**

BY 2018, AUTONOMOUS VEHICLES COULD PROVIDE TRANSPORTATION SERVICES AT NEAR COST PARITY TO THE TOTAL COST OF OWNING AND OPERATING A PERSONAL VEHICLE—UNDER \$1.00 PER MILE.



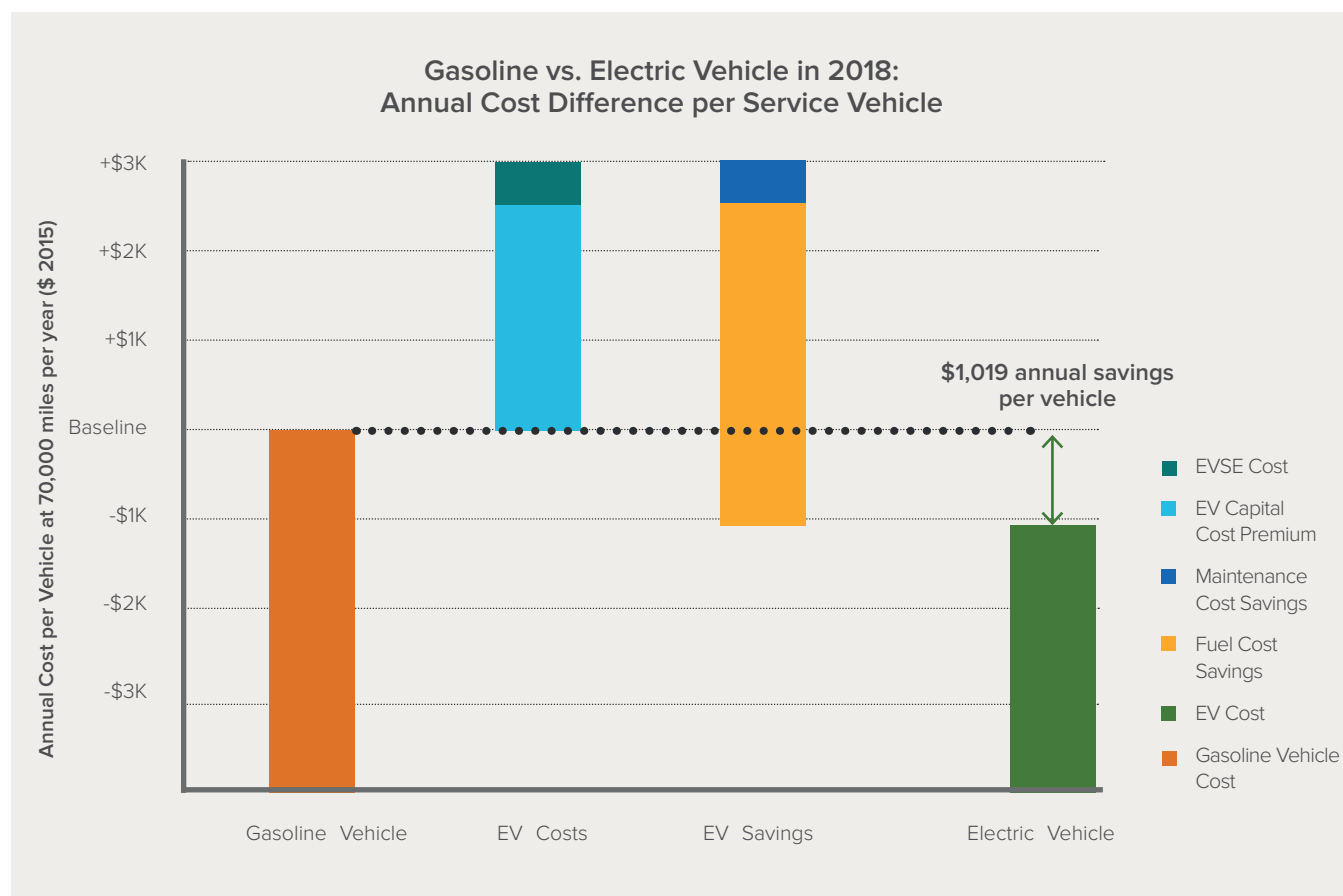
Upon debut, fully autonomous vehicles could reduce the cost of on-demand point-to-point mobility services like Uber and Lyft to near cost parity with owning and driving a car (around \$0.85 per mile), allowing consumers to economically choose these services

exclusively over a personal vehicle (see Figure 1). Despite current technological and potential regulatory barriers, many of the world's most powerful companies are racing to deploy automated mobility services as soon as 2017 in certain U.S. cities.

## 2. Electric vehicles make strong economic sense to provide automated mobility service.

**FIGURE 2:**

MODEL YEAR 2018 ELECTRIC VEHICLES WILL HAVE IMMEDIATE COST ADVANTAGES OVER TRADITIONAL GASOLINE VEHICLES IN MOBILITY SERVICES. THIS ADVANTAGE WILL ONLY GROW AS EV TECHNOLOGY MATURES.



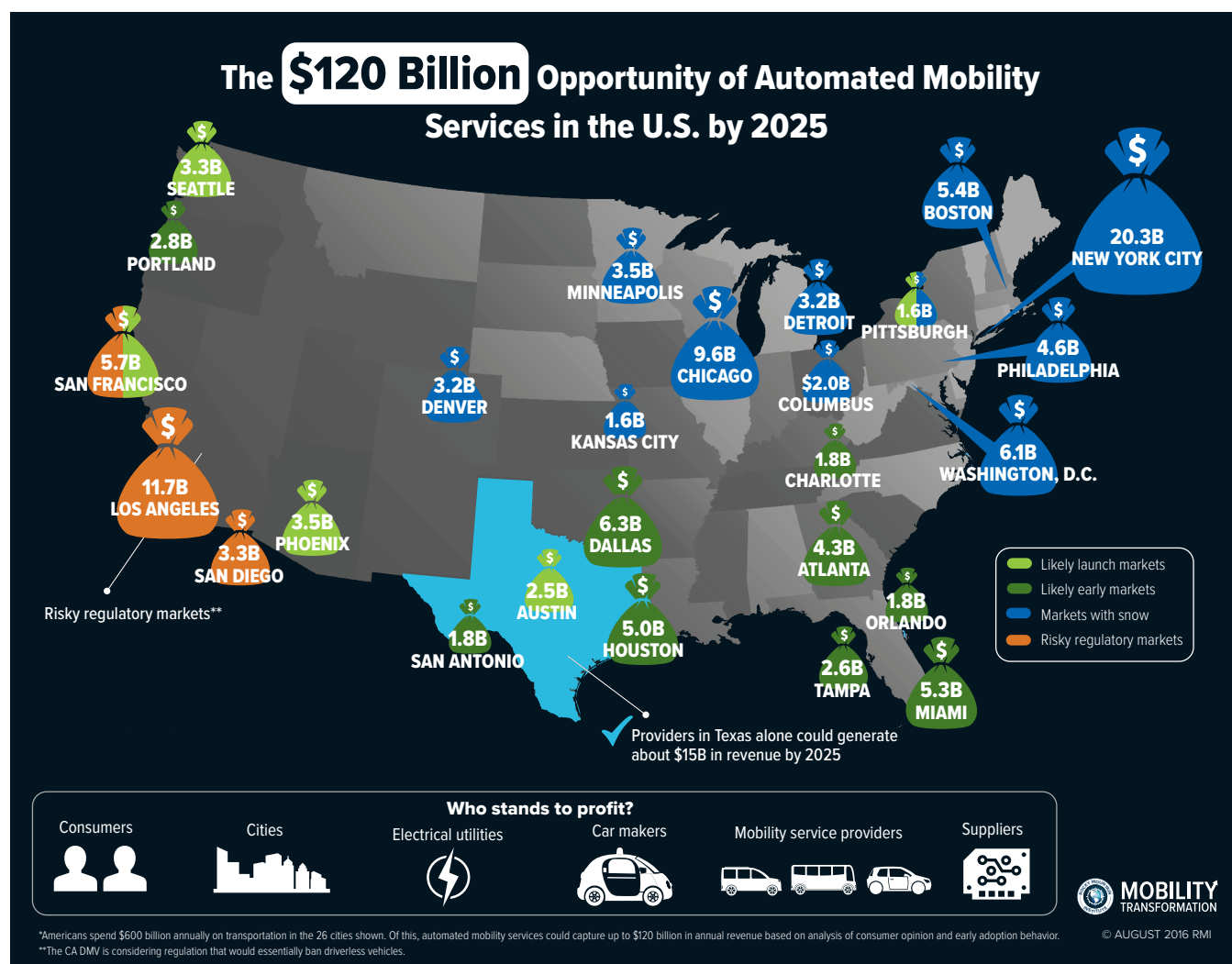
At the high mileage driven by mobility service vehicles, model year 2018 electric vehicles (EVs) such as the Chevy Bolt and Tesla Model 3 could save mobility services providers over \$1,000 annually per vehicle versus a comparable gasoline vehicle (see Figure 2). This is due to lower operating costs that more than compensate for higher capital costs

(even without subsidies). As battery costs fall and EV production reaches full scale, the cost advantages of EVs will only grow and should lead to at least \$4,000 annual savings per vehicle by 2030, equivalent to ~\$200 billion in total fleet savings per year. Economics should impel automated service providers to deploy electric autonomous vehicles (EAVs).

### 3. The total mobility market of the first 26 U.S. cities where automated mobility service will likely launch is worth ~\$600 billion.

FIGURE 3:

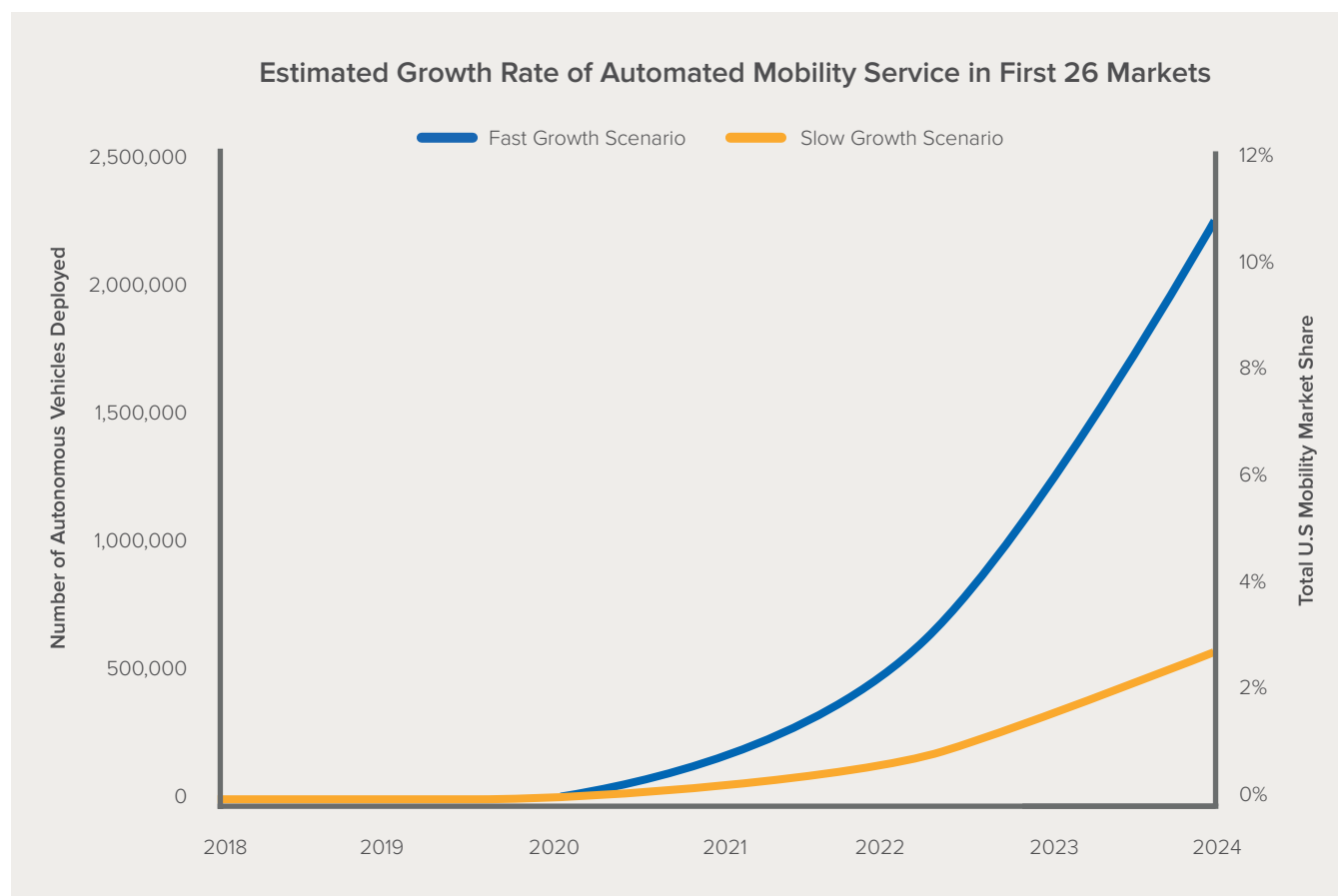
RANKING THE MOBILITY MARKET OF VARIOUS U.S. CITIES. IN THESE MARKETS, AT \$1.00 PER MILE, ANNUAL REVENUE FROM AUTOMATED MOBILITY SERVICES COULD BE OVER \$100 BILLION—OR ABOUT 10% OF THE TOTAL U.S. MOBILITY MARKET IN 2025.





**FIGURE 4:**

ESTIMATED GROWTH RATE OF AUTOMATED MOBILITY SERVICE IN FIRST 26 MARKETS



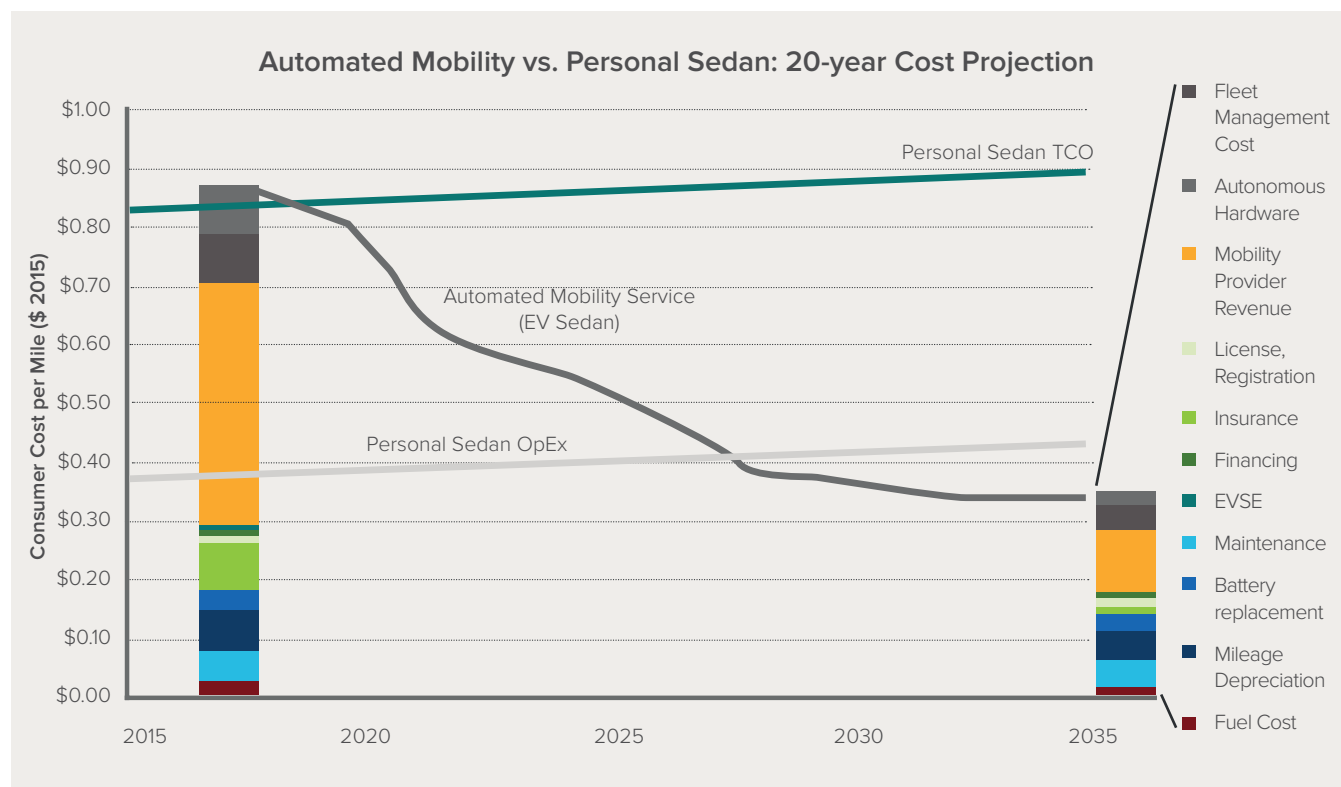
Based on existing use of services like Uber and Lyft, paired with surveys of consumer acceptance of autonomous vehicles and automated mobility services, the U.S. “early adopter” pool for automated mobility service appears to be quite large, particularly at a price

point of \$1.00 per mile or lower. By rolling out service strategically in U.S. markets, early-to-market automated mobility service providers could capture over \$100 billion in revenue at the expense of incumbents like oil companies and traditional carmakers.

#### 4. Automated mobility services could capture two-thirds of the entire U.S. mobility market in 15–20 years.

FIGURE 5:

COST OF AUTOMATED MOBILITY VS. PERSONAL SEDAN



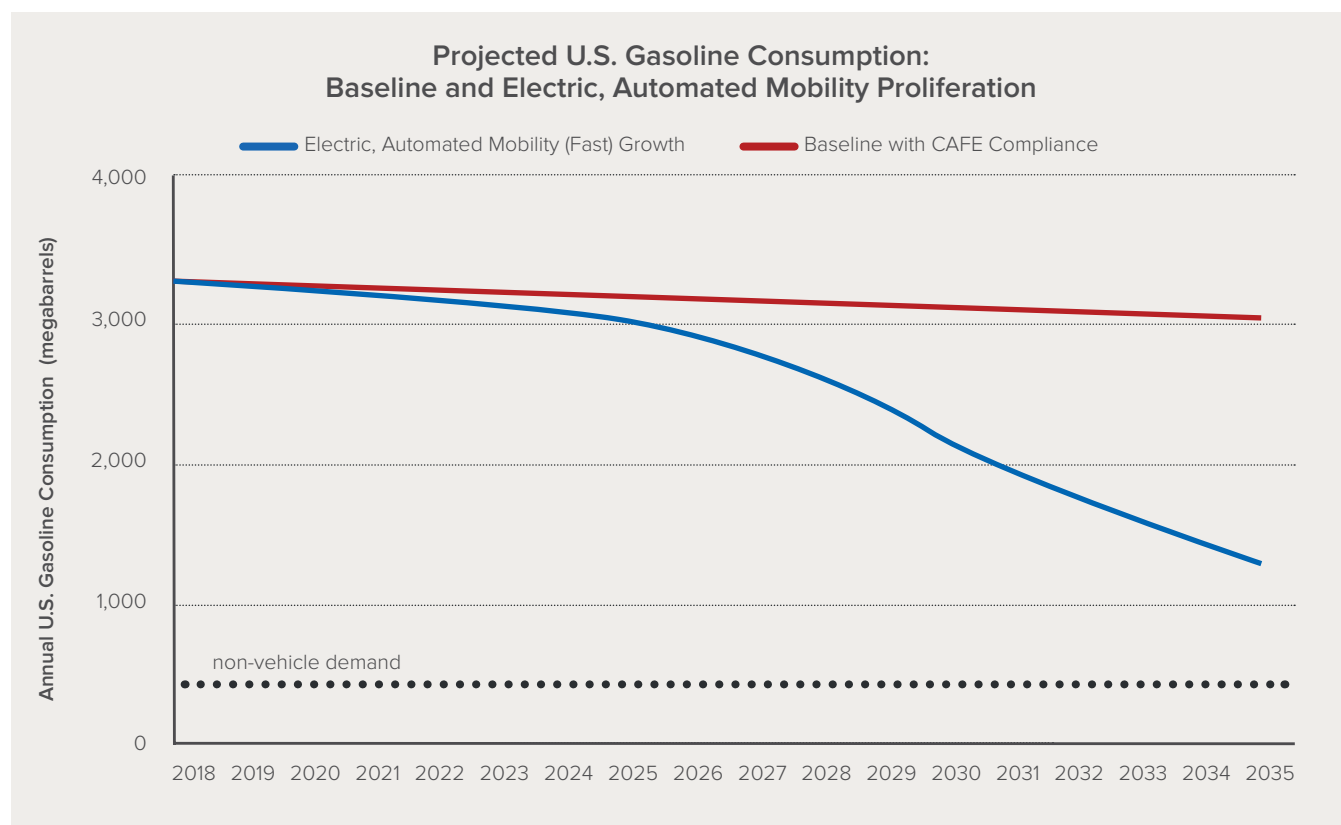
Second-generation electric autonomous vehicles and services could reduce automated mobility costs below the operating cost of a personal vehicle (~\$0.30/mile). At this price, car owners could utilize automated mobility services frequently/exclusively with no cost increase over driving their own vehicle. Low cost, combined with increasing breadth of vehicle and service offerings,

would open most of the mobility market to automated mobility service providers. Potential pitfalls and unknowns may limit automated mobility service growth, but tech leaders, governments, and other stakeholders are working on making the proliferation of electric automated mobility service a reality.

## 5. Oil companies will lose revenue, utilities will gain, and carmakers will be split.

**FIGURE 6:**

GASOLINE DEMAND WILL DROP SHARPLY AS ELECTRIC SERVICE VEHICLES DISPLACE PERSONAL GASOLINE-POWERED VEHICLES.

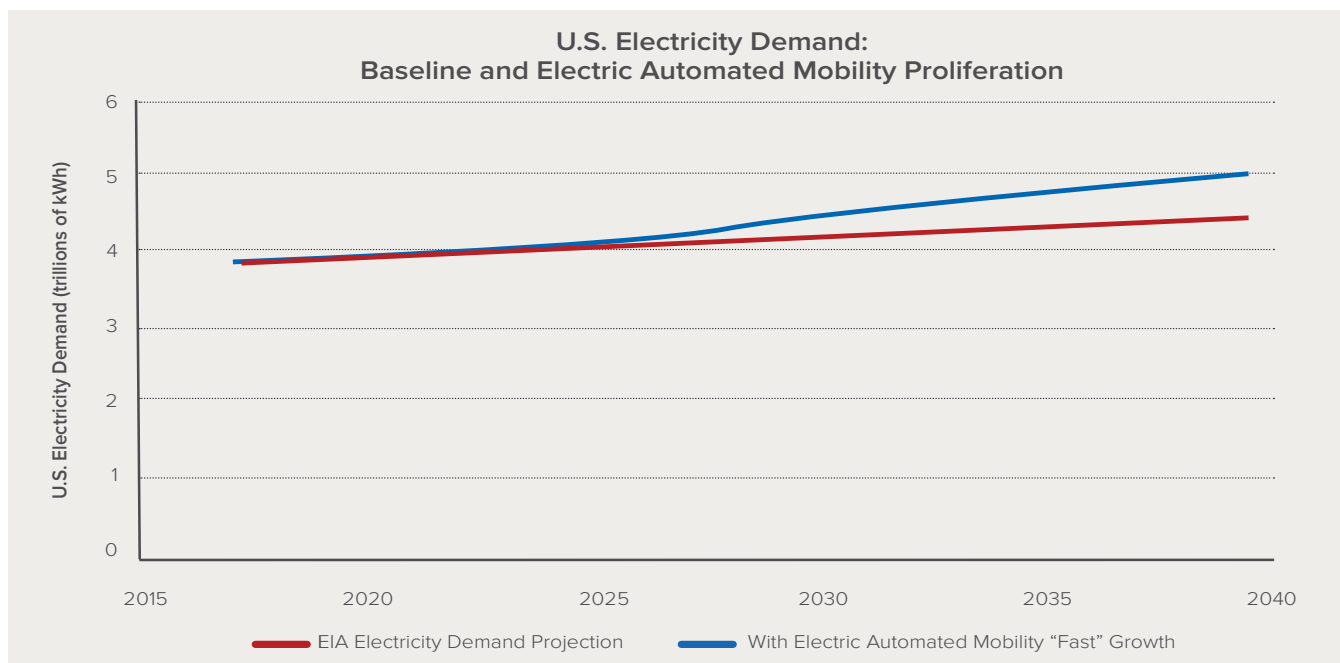


Electric vehicles could displace gasoline vehicles very quickly in a mobility service paradigm. Due to high annual mileage, service vehicles will turn over in about five years instead of ten to fifteen for personal vehicles.

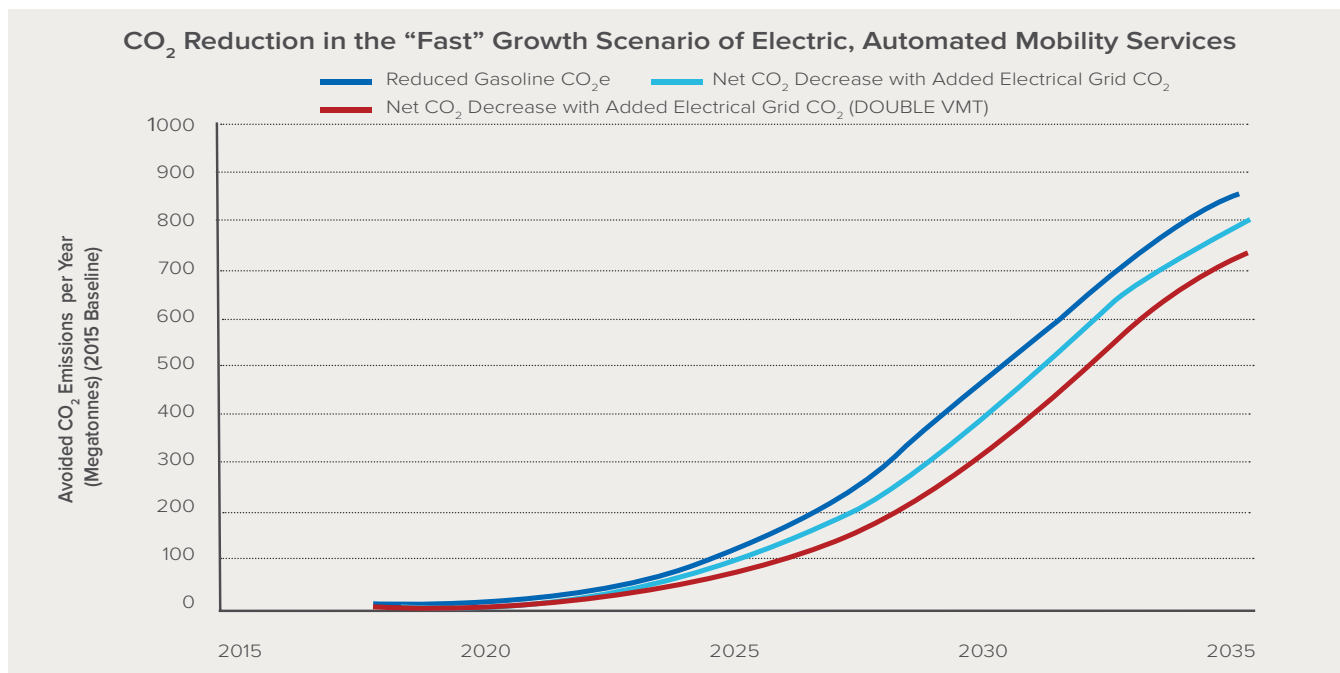
Due to compelling economics, most of the automated service vehicles should be electric by 2025. This quick introduction and quick turnover could lead to gasoline demand dropping by two-thirds by 2035.



**FIGURE 7:** THE INCREASE IN ELECTRIC VEHICLE MILES TRAVELED (EVMT) COULD INCREASE DEMAND FOR ENERGY FROM ELECTRICAL UTILITIES BY 10%.



**FIGURE 8:** WITH MASS AMOUNTS OF EVS FUELED BY A RELATIVELY CLEAN GRID, CARBON DIOXIDE FROM PERSONAL MOBILITY PLUMMETS.

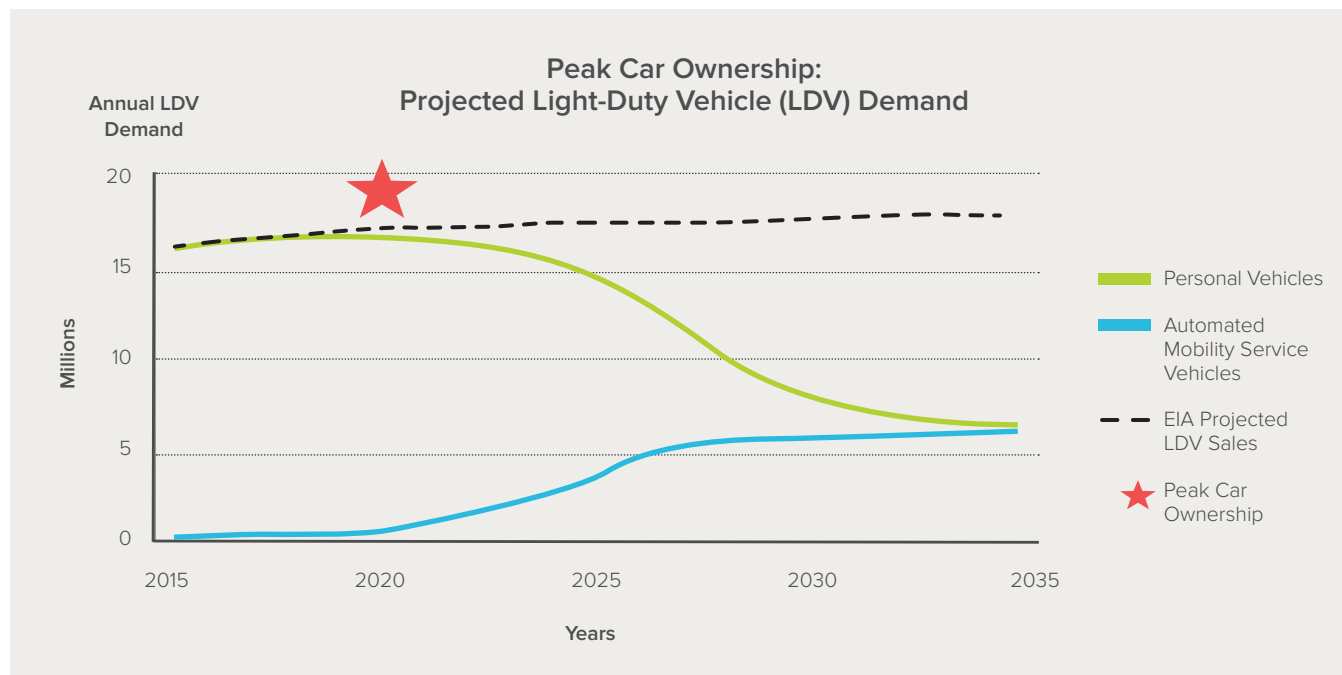


It is critical that electrical utilities are prepared for a fast influx of electric vehicle demand. Rate design and electric

vehicle supply equipment (EVSE) siting will be critical considerations to ensure charging is a boon to the grid.

**FIGURE 9:**

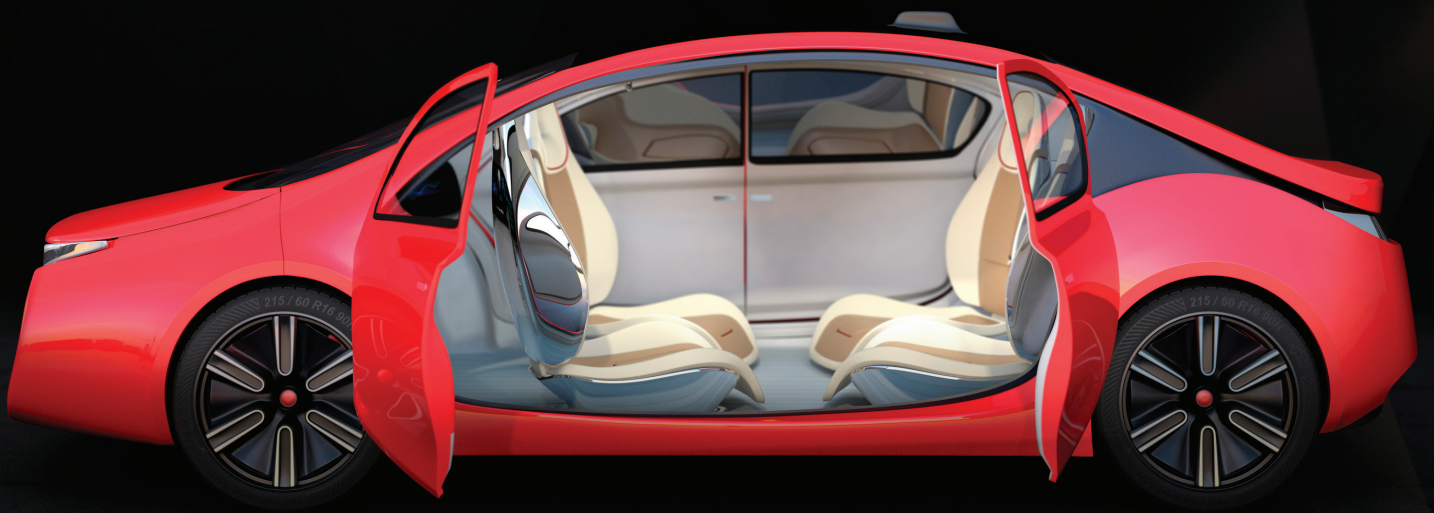
PERSONAL VEHICLE DEMAND COULD DROP 40% AS FEWER VEHICLES DO MORE WORK, BALANCED BY NEW REVENUE SOURCES FOR THE CARMAKERS THAT EMBRACE THE CHANGING MARKET AND DEPLOY THEIR VEHICLES IN THE AUTOMATED SERVICE PARADIGM.



## OUTLOOK

According to our modeling, peak car ownership in the United States will occur around 2020 and will drop quickly after that. This could lead to a clear delineation between winners and losers based on which auto companies capitalize on emerging business models for mobility services and which do not. In addition, the speed and complexity of this disruption could favor new entrants that are used to a rapidly changing consumer and technology landscape and fast turnover of product. New entrants also have lower risk of stranded assets that are already deployed (or planned) for a personal vehicle-centric market.

On the positive side, carmakers that excel in providing autonomous vehicles and automated mobility services stand to prosper greatly in the next two decades. As personal vehicle demand drops, demand for autonomous vehicles to perform mobility services will grow. Demand for autonomous service vehicles will compensate for lost demand for personal vehicles for several years, but ultimately the vehicle fleet will shrink considerably. But carmakers that provide mobility services and autonomous vehicles could reap substantial profit since our current system costs around \$0.80 per mile, and mature electric automated mobility service could cost only \$0.30 per mile. That difference of \$0.50 per mile equates to over \$1 trillion in total savings that will be split between society, consumers, and the mobility service providers of the future.



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