WESTFIELD
CAPITAL MANAGEMENT

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The Automotive Renaissance

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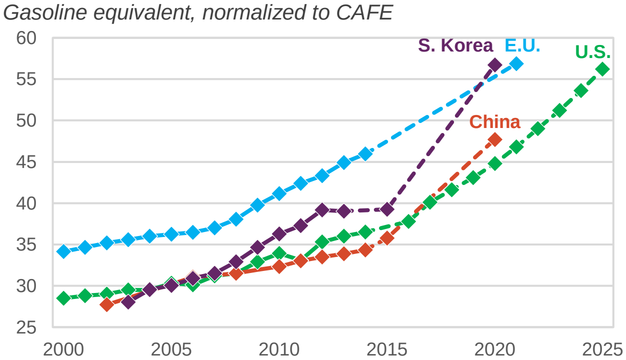
Every day 1.1 billion vehicles worldwide take to the roads, and in the process consume roughly 77 million barrels of oil, produce 100,000 tons of carbon dioxide, cause 3,425 fatal car crashes, and create approximately $1.7 billion worth of economic drag from congestion.[1] If the current statistics aren't staggering enough, the predictions over the next 20 years surely are. However, changes underway within the auto industry show promise in altering the current trajectory by providing solutions to address the great environmental and societal burdens of our transportation bottleneck. In some instances, creating solutions to such "sustainability" themes provide great societal benefits, but not necessarily commensurate financial compensation for the key stakeholders responsible for the progress made. We believe the evolution of the auto is different due to the significant economic opportunity that solving these challenges also represents.

Through technological advances, significant investment, and even, at times, governmental regulation, the industry is transforming the way it designs and builds the automobile, resulting in a fleet of new vehicles hitting the roads today and in the future that are greener, safer, and more autonomous. With this paper, we seek to shed light on the evolution of the automobile by taking a close look at three key industry trends and their economic ramifications. While it remains too early to choose winners and losers in this race with certainty, it is safe to say that the economic impact of progress towards a greener, safer, and more autonomous fleet will reach far beyond the transportation industry, providing investable opportunities across many different industries.

GREENER VEHICLES

Transportation is the second largest contributor to global greenhouse gas emissions, and therefore is a primary target of governments around the world seeking to reduce environmental impact. The industry's regulators have significant influence over the rate of vehicle emissions, providing regulated standards that Original Equipment Manufacturers (OEMs) must follow. As such, the standards looking forward act as guideposts for new vehicle designs and restrictions are moving higher across the globe. Current proposed and enacted emission standards in the E.U., U.S. and China call for reductions in CO_2/km emissions ranging from 27% to 39% by 2020.

Exhibit 1: Efficiency standards across the world are raising the bar
Passenger Car MPGs: Realized Results and Enacted Standards
Gasoline equivalent, normalized to CAFE



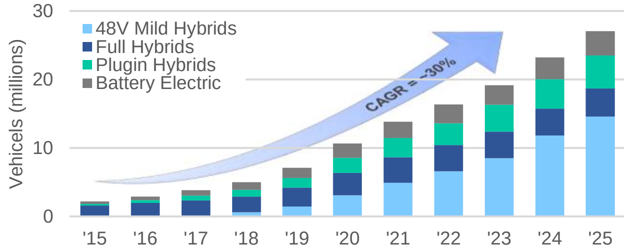
Source: The International Council on Clean Transportation, September 2015

A decade ago, these standards would have seemed like lofty and maybe even foolish proposals. However, technological advancements are accelerating efficiency gains in new vehicles, making the task of achieving these targets not only possible, but probable. In fact, we believe that regulatory compliance with these new standards is highly likely, especially given the financial penalties to the OEMs if they fall short.

The acceleration of fuel efficiency gains is occurring on two fronts. First, the incorporation of new technologies within the internal combustion engine (ICE) has been shown to reduce vehicle emissions by 15-20%[2]. Companies such as BorgWarner Inc. are developing highly engineered products designed to improve ICE efficiency such as Exhaust Gas Recirculation, Stop/Start engines, and Turbo Chargers. The second and more impactful development is the electrification of the powertrain in the form of 48-volt mild hybrids, full hybrids, and fully electric vehicles (EVs). As utilization of these low or no emission vehicles increases, electric powertrains will represent an ever growing percentage of the total fleet and their impact on fleet-wide fuel efficiency statistics will continue to grow. We have seen bold commitments to the exclusive production/sale of hybrid and electric vehicles by countries such as Norway, and OEMs such as Volvo Car Corp., by 2025 and 2019, respectively. Looking ahead, the number of electrified vehicles sold per calendar year is projected to grow at a 30% annualized rate over the next decade, resulting in annual sales surpassing 27 million units by 2025[3].

Exhibit 2: Electric vehicles are gaining share at an increasing rate.

Electric Vehicle Sales



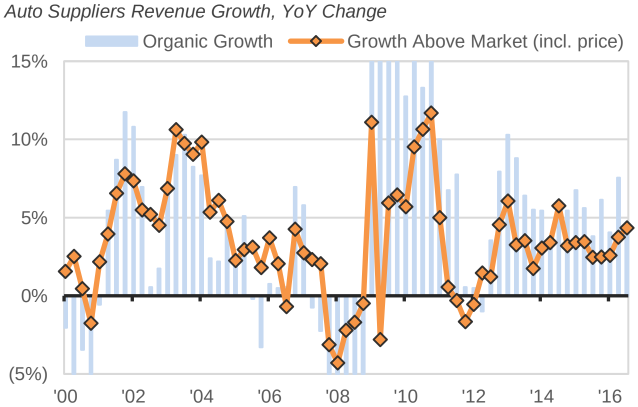
Source: Delphi Automotive PLC, IHS, as of November 2016

We believe the increased penetration of technologically advanced products, both those targeting increased ICE efficiency and those incorporated into electric vehicle architectures, should result in demand for these products outpacing production growth over the next five years, as it has for the last five (see Exhibit 3). As a result, the relative appeal of the content providers compared to the OEMs is becoming more pronounced and transforming certain segments of the auto industry from traditionally cyclical groups into attractive secular growth opportunities.

Exhibit 3: Outside of recessions, auto suppliers have maintained growth above total production growth averaging 3-4%.

Quarterly Organic Growth and Growth Above/Below Market

Auto Suppliers Revenue Growth, YoY Change



Source: Baird Equity Research, FactSet, as of August 2017

SAFER ROADS

Vehicular accidents are currently the 10th leading cause of death in the world and it should come as no surprise that improving vehicle safety has long been a focus of regulators, car makers, and consumers alike. Until recently, the safety technology within the traditional auto was limited to "passive" safety features (think seat belts and air bags) that have shown to be effective at reducing injuries and saving lives once accidents occur, but play no role in preventing them from ever happening.

However, a new generation of safety technology is rapidly developing focused on "active" safety, which seeks to automate the task of driving by removing the human element. These active safety technologies, both those currently available and those under development, provide a range of vehicle automation which the National Highway Traffic Safety Administration (NHTSA) has categorized into groupings based on driver vs. vehicle control as shown below.

Exhibit 4: Levels of Vehicle Automation

Level 0 – Driver is in complete control of vehicle
Level 1 – Automation of one or more control functions
Level 2 – Automation of two or more control functions
Level 3 - Driver cedes full control under certain conditions
Level 4 – Driver cedes full control for an entire trip
Level 5 – Full self-driving automation (no driver required)

Source: National Highway Traffic Safety Administration, as of July 2014

With 94% of U.S. vehicular accidents caused by driver error[4], what impact would automating the driving experience and thereby drastically reducing such errors have on crash statistics? While detailed studies on the crash reduction rates for fully autonomous vehicles remain either theoretical in nature or conducted on closed courses, some real world data exists today that shows how automating even small elements of driving can significantly improve vehicle safety. According to studies conducted by IIHS, lane departure warning systems lowered rates of relevant injury crashes by 21%, blind-spot detection systems reduced lane-change crashes with injuries by 23%, and automated braking systems cut the rate of front-to-rear collisions in half.

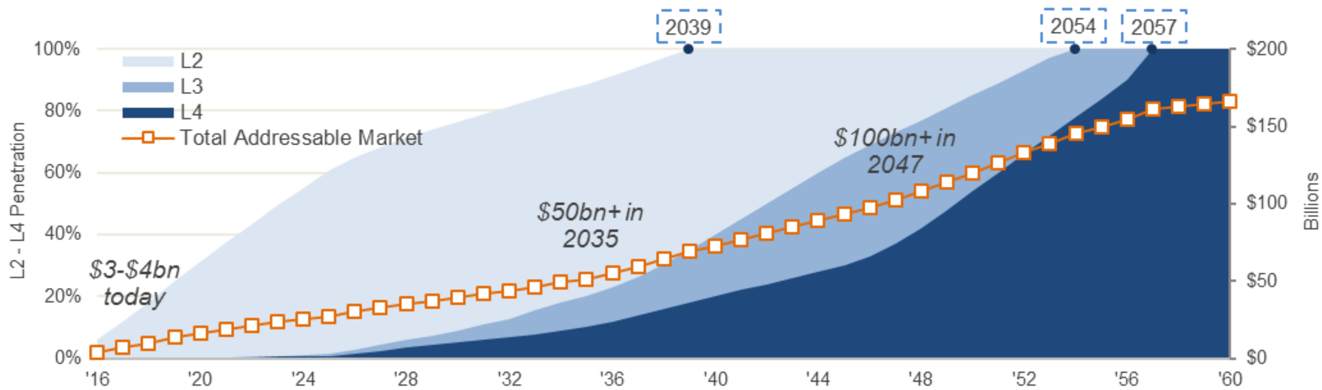
Despite these improvements, considerable progress is still required to meet the aggressive safety targets set by highway safety organizations. In the U.S., the NHTSA has a goal of zero traffic deaths within the next 30 years, and the E.U. regulatory agency has a target of cutting the fatality rate in half from 2010 to 2020. Much like the emissions standards, these targets for reductions in auto accidents seemed unachievable not too long ago, but today appear more realistic as the whole industry innovates and furthers the development of "active" safety technology. Through rapid development of software and hardware technology, the sensors, cameras, and artificial intelligence required for vehicle automation either exists today or is quickly coming to market. For the OEMs, not only is demand for these features robust, but they are also incentivized to incorporate these features into new builds because the added costs associated with their inclusion are easily passed through to consumers willing to pay a premium for safety. For the supplier base, led by companies such as Delphi Automotive, Valeo, Autoliv

Inc., Intel/Mobileye, and Nvidia Corp., the very large $100 billion addressable market is growing 40-50% per year[5].

Given aligned goals and rapidly developing technology, the adoption rates for Level 2 (partially automated) through Level 4 (fully automated, driver remains in seat) active safety in new vehicles is forecast to be fully penetrated over the next 40 years, up from 10% today.[6] At full adoption of Level 4 active safety features, accident rates and fatalities are projected to fall over 90% from today's levels and the subsequent economic benefit to society would be $600 billion to $1 Trillion in savings[7]. Simply stated, these are massive societal benefits.

robust demand. From a cost perspective, the network must achieve cost parity to owning a vehicle. The increased efficiency and lower costs per mile of electrified vehicles make them the clear favorite compared to gas-powered alternatives. Concurrently, the system needs fully autonomous Level 5 vehicles which eliminate the cost of the driver, improve network efficiency, and provide a much safer rider experience. Consensus predictions call for the adoption of autonomous fleets first in commercial vehicles, since the elimination of the driver in these highly utilized assets more than pays for the increased technological costs. The next phase of adoption will be passenger vehicles in urban settings that

Exhibit 5: Full adoption of L2 - L4 expected over the next 40 years
Autonomous Evolution of Global New Vehicles L2 – L4



Source: Evercore ISI, as of July 5, 2017

While long term projections highlight a much safer future for transportation, the technologies in the market today (Level 2 safety features and Level 3 automation) are having an immediate beneficial impact on vehicle safety. According to Delphi Automotive, a diverse supplier of active safety products, 80% of the estimated safety benefit can be achieved at Level 3 automation. Based upon this view, the societal benefits should begin accruing shortly.

MORE AUTONOMOUS TRANSPORTATION

The last stage in the evolution of the auto is the creation of connected, fully autonomous vehicles, which represent the union of improved fuel economy, safer travel, and more efficient use of capital assets. This transformation is catalyzing the fully autonomous ride sharing network shift. Today these networks remain experimental but early studies suggest that in urban settings sizeable benefits such as 28% fewer vehicles on the road, 30% less travel time, 66% less CO_2 emissions, and an 87% reduction in traffic accidents could be realized[8].

So what does an efficient ride sharing network require? Simply put, a ride sharing network needs demand, attractive cost per mile economics, and a safe experience. On the demand front, growth at ride sharing companies such as Uber and Lyft clearly demonstrate

can satisfy the density requirements for the economics to work. An efficient autonomous network is estimated to cost $0.35-$1.00/mile compared to the cost of a personal car in the range of $0.60-$0.80/mile[9]. At this level, the convenience and safety of the network would perpetuate demand.

While the development of truly autonomous vehicles and networks is still in the early innings, innovation leaders in the group have created systems that show promise in addressing the challenges presented by the driverless car. For example, Mobileye has internally developed a system that addresses the need for highly accurate live maps to set the future path of the driverless car. Current commercially available map technology uses GPS which provides accuracy down to 10 meters but is inadequate for fully autonomous driving. Mobileye's Road Experience Management system takes a unique approach to solving the challenge by utilizing their installed base of cameras and crowdsourcing technology to create maps of the globe with accuracy down to 3-4 inches, materially improving the car's ability to react to its changing surroundings on the road. Another key challenge will be processing, storing, and securing the data generated by autonomous vehicles. According to current estimates, each driverless car will generate approximately 4,000 GB of data in one day of driving which is equivalent to the daily data consumption of 3,000 people[10]. Properly handling the explosion of data created by automated vehicles will not be solved by one company's innovative solution, but instead stands to create long-term growth opportunities across semiconductors, tech hardware, data security, mobile infrastructure, data storage, real estate, etc. In addition to the primary providers of automated vehicle technology, these ancillary beneficiaries could prove to be equally compelling investment opportunities to capitalize on these trends.

LOOKING AHEAD

Despite the progress made to date, it remains early in the development of fully autonomous vehicles. However, with youth comes great opportunity as these trends have long growth runways until the full saturation of autonomous vehicles fleet-wide occurs. Current long-term projections estimate the mass adoption of fully autonomous vehicle fleets in the U.S. could take another 40 to 50 years to be fully implemented. Along the way, many hurdles will have to be cleared and a few are included below:

- Regulators need to enact appropriate laws and regulations to govern these rapidly advancing technologies.
- Costs for Level 5 systems need to decline by 80-90% for mass adoption to be practical.
- Ensuring software security will be paramount as the amount of data generated grows exponentially.
- Investments in public infrastructure need to take place.

This list is not meant to be exhaustive and we are confident that there will be plenty more challenges along the way. With that said, we are equally confident that analogous to every other major technologically-driven shift (computers, the internet, smart phones, the cloud), innovation over time will bring costs down, which will drive demand and in turn lead to solutions to these challenges. There will be long-term winners and losers as a result of this progress, but we would suggest that the developments underway are creating sustainable secular growth opportunities today for those innovative companies strategically positioned to drive forward the advances. Importantly, in addition to creating unique investment opportunities, the changes taking place within the industry have the potential to provide meaningful and long lasting societal and environmental benefits. We continue to conduct exhaustive research in this exciting growth area and remain focused on identifying compelling investment ideas moving forward.

[1] WardsAuto, U.S. Energy Information Administration, World Health Organization, U.S. Environmental Protection Agency, BorgWarner Inc., Delphi Automotive PLC, Centre for Economics and Business Research, Westfield estimates.
[2] Delphi Automotive PLC, BorgWarner Inc.
[3] Delphi Automotive PLC, January 2017. Data from IHS as of November 2016.
[4] National Highway Traffic Safety Administration
[5] EvercoreISI Automotive Research, December 2016
[6] EvercoreISI Automotive Research, December 2016.
[7] EvercoreISI Automotive Research, December 2016.
[8] Delphi Automotive PLC, January 2017. Research by Arthur D. Little.
[9] EvercoreISI Automotive Research, ARK Investment Management LLC, May 2017.
[10] Intel Corporation, November 2016.