



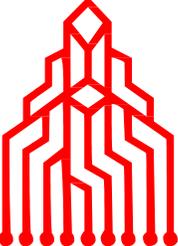
CABA Connected Home Council (CHC)

CABA White Paper



THE CONNECTED CAR: LIFESTYLE IMPACT ON CONSUMER & THE ECOSYSTEM

COMPASS INTELLIGENCE
A GLOBAL CONSULTING & MARKET ANALYTICS COMPANY



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ABOUT CABA

The Continental Automated Buildings Association (CABA) is an international not-for-profit industry association, founded in 1988, and dedicated to the advancement of intelligent home and intelligent building technologies. The organization is supported by an international membership of over 300 organizations involved in the design, manufacture, installation and retailing of products relating to “Internet of Things, M2M, home automation and intelligent buildings”. Public organizations, including utilities and government are also members. CABA's mandate includes providing its members with networking and market research opportunities. CABA also encourages the development of industry standards and protocols, and leads cross-industry initiatives. CABA's collaborative research scope evolved and expanded into the CABA Research Program, which is directed by the CABA Board of Directors. The CABA Research Program's scope includes white papers and multi-client market research in both the Intelligent Buildings and Connected Home sectors. (<http://www.CABA.org>)



ABOUT CABA'S CONNECTED HOME COUNCIL (CHC)

Established in 2004, the CABA Connected Home Council initiates and reviews projects that relate to connected home and multiple dwelling unit technologies and applications. Connected homes intelligently access wide area network services such as television and radio programming, data and voice communications, life safety and energy management/control information and distribute them throughout the home for convenient use by consumers. The Council also examines industry opportunities that can accelerate the adoption of new technologies, consumer electronics and broadband services within the burgeoning connected home market. (<http://www.CABA.org/connected-home-council>)



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State of the Market

The connected car market, while still in its infancy, has rapidly evolved from a niche capability available in select models to a perceived must-have in the car industry. A connected car, by definition, is one that maintains a wide area connection (typically cellular-based) and often also a local area network (typically Wi-Fi). Via these connections the car is able to send and receive information relevant to the trip/route and the car's performance/condition.

An increasing number of vehicles are coming to market with the capability to support communications of various sorts. In 2013 more than one (1) billion sensors were sold to the auto industry, more than doubling the 2009 levels^[1]. While tethered and integrated solutions have dominated car connectivity to date, embedded connectivity solutions began appearing in 2014 with the number of such vehicles increasing in 2015 and beyond. Spurring the growth in connected car solutions coming to market are a series of key drivers, including:

- **Regulations:** The impact of government regulation on the direction and pace of connected car development will be significant. A pro-government position, or possibly a mandate, will quicken the pace of development, while a resistant or disinterested position will limit development. Many governments, especially in Europe, recognize safety benefits of connected car developments and may put regulations in place mandating certain aspects of connectivity to be incorporated in new vehicles brought to market.
- **Standardizations:** As is typical with new markets, multiple technologies are emerging in the connected car market. Because much of the value in the connected car space is for vehicles to communicate with one another, it is important that these vehicles outfitted with varying technologies are compatible. Standardization is sometimes slow to evolve, however, the process is underway in the connected car space with two (2) European standards organizations, ETSI and CEN, announcing in early 2014 that the basic set of standards requested by the European Commission to make connected cars a reality has been fully completed. The EU is blazing the trail in this new territory, the connected car market would benefit from similar standardization efforts in the US and other markets.
- **LTE deployment:** LTE's bandwidth and low latency are expected to enable high-definition audio and video streaming, allow real-time video diagnostics and provide more accurate real-time traffic information. The pace of LTE deployment will impact the performance of, and thus demand for, connected cars.

- **Smartphone independence:** As apps migrate from natively hosted on smartphone devices to cloud-based storage, individuals will be less bound to their smartphones and thus more apt to embrace embedded car connectivity that is able to access their personal bundle of apps, music, contacts, etc.

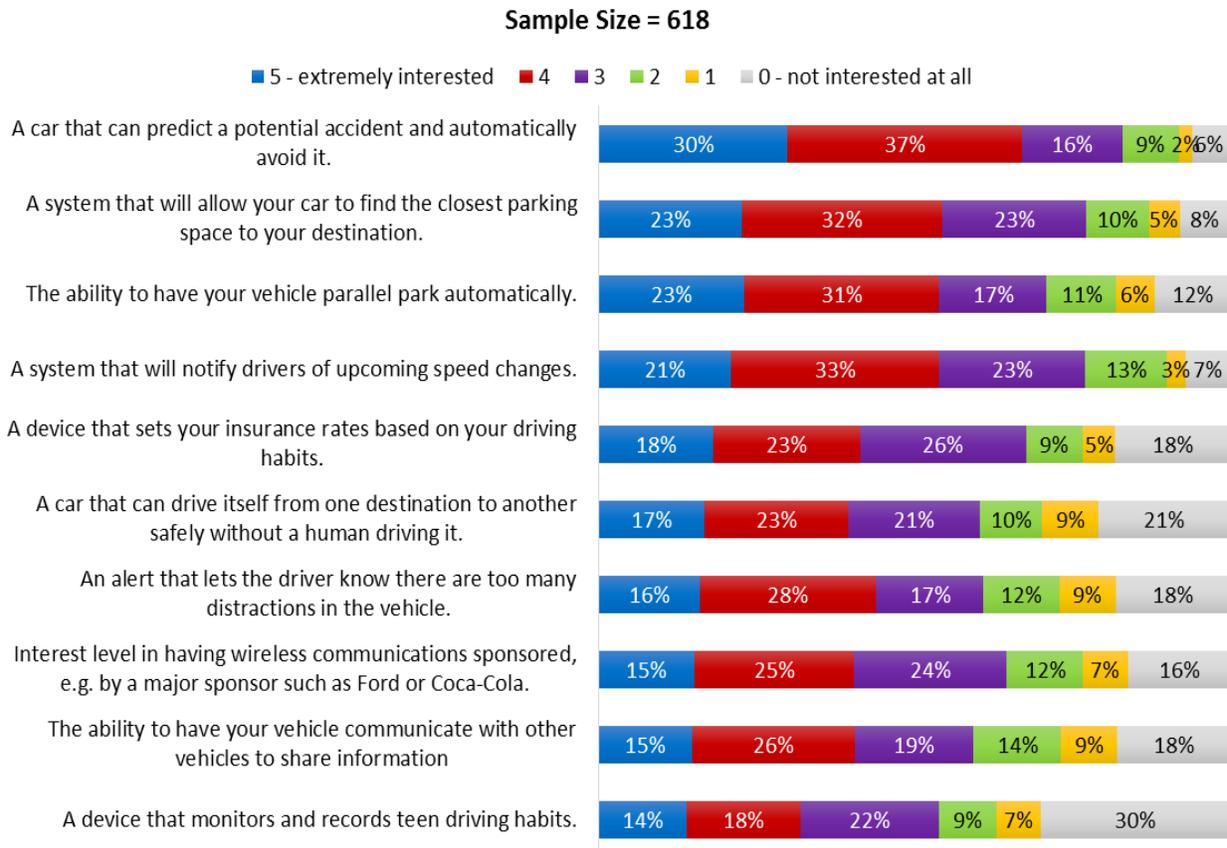
End-User Perception

The connected car is forging a new realm of connectivity and it is yet unclear which aspects of the connected car capabilities that consumers will demand and value most. According to initial research, however, on the subject it appears that consumers intend to use vehicle connectivity in a significantly different way than other connectivity devices. Popular activities on smartphones and tablets, including app usage and social networking, appear to appeal to relatively few consumers. Consumers appear to gravitate more toward safety, vehicle diagnostic and maintenance features as well as navigational capabilities.

Telefonica conducted a study in early 2014 of consumers in United States, Britain, Germany, Spain and Brazil, which indicated that many people are not presently interested in downloading applications and social networking while driving^[2]. Rather, people were most interested in emergency alert systems and notices about maintenance for their cars.

In 2014, Compass Intelligence conducted an end-user survey on the connected car, some of the preliminary results are displayed in this white paper.

Question: And, on a scale of 0 (not interested at all) to 5 (extremely interested in the service), please rate your level of interest in the below services.



Source: 2014 Compass Intelligence

Currently companies are developing solutions to meet end-user requirements. To make end-users more aware of the connected vehicle, GM has unveiled their approach: the car manufacturer giant began in mid-summer a free trial program for those vehicles shipping with AT&T 4G LTE embedded. In the first month of the trial a staggering 98% of customers opted in on the free trial. So while conceptually consumers are still very wary of the connected car concept, when presented with the opportunity to try it hands on and play with, there seems to be strong interest.

Challenges and Strategies

Stimulating consumer demand is not the only challenge that the connected car industry faces. Bringing connectivity to the vehicle, in particular a vehicle in motion, introduces new questions from a technology and regulatory perspective that must be addressed in order for the connected car market to advance. There are a variety of points that the industry must work through, with the following being among the more critical:

- **Standards:** The development of standards will be of vast importance in the connected car market as much of the value in the technology relies on cars being able to “talk” to one another-- exchanging speed, position, and other safety data up to 10 times per second. If connected cars are operating on multiple different technologies that are not compatible, this capability will be lost. Early stage standards efforts are underway, such as the AllSeen Alliance, a body of 50 members across multiple industries, which works toward the goal of open sourcing.
- **Regulations:** The automotive market is subject to a high degree of governmental regulation. As indicated previously, governmental perception, whether favorable or negative, will be critical to the market path for connected cars. Favorable dispositions will accelerate market development. In February 2014 the US Department of Transportation's (DOT) National Highway Traffic Safety Administration (NHTSA) announced plans to enable vehicle-to-vehicle (V2V) communication for light vehicles. This technology is designed to allow vehicles to talk to each other. The NHTSA is also developing a regulatory proposal that would require V2V devices in new vehicles, but that will be at a later date. More recently, the NHTSA announced in early August 2014 rules that govern vehicle-to-vehicle and vehicle-to-infrastructure communications that will provide the foundation for the autonomous-car environment^[3].
- **Privacy:** Connected car devices track drivers’ behavior in terms of acceleration, location, and other data points. This data belongs to the user but they will have the option of sharing this data with third parties in order to receive discounts, deals, etc. Users may be sharing more than intended however. For instance, even without GPS coordinates, a driver’s location can be reconstructed given starting point and acceleration. Furthermore, as connected car owners begin selling these vehicles as used cars, there is the question of how to remove their personal data as there is no factory default reset buttons, so to speak, for these systems. Clearer privacy rules to protect driver’s

information and safeguard that only what they intend to share is being released will be an issue of consideration as the market develops.

- **Security:** Vehicle-based apps bring the threat of car-hacking. Malware-laden apps are prevalent and on the rise and it is anticipated that as these apps migrate to the connected car market that hackers will be able to gain access to certain aspects of the car's functioning. The National Highway Traffic Safety Administration has launched a research study aimed to better understand cyber-threats on autonomous vehicles. Independent studies conducted by the U.S. Department of Transportation have also indicated that automobiles are susceptible to hacking. Car manufacturers have been made aware of this problem and are actively working to combat these challenges.
- **Safety:** One of the most compelling drivers for connected cars from both a governmental regulatory perspective as well as a consumer interest perspective is the safety features. Because the majority of accidents are due to driver error, eliminating, or minimizing, the human element should reduce the number of accidents. Driverless cars do not make the poor decisions that human drivers make such as running lights, speeding, or distracted or drunk driving. Because connected cars are theoretically less likely to crash, they can be designed lighter and more fuel-efficient. Also, because machines are more precise and reliable drivers than humans, driverless cars could safely drive closer together, thus increasing highway capacity. According to research conducted by the University of Michigan, roughly three-fourths of respondents said that connected vehicles will reduce the number and severity of crashes, improve emergency response times and result in better fuel economy. Furthermore, for the majority of respondents, safety was the most important aspect of connected-vehicle technology, compared to mobility and environment.

Market Trends

Autonomous Car

The extreme vision for the connected car is a driverless vehicle that completely removes the need for a human driver. These robotically chauffeured vehicles, while futuristic in concept, may be a not too distant reality. Several projects are in motion to make the driverless car a reality. Most notable among these efforts is Google's Driverless Car, a project that the technology giant has been involved with since 2009. Google is operating a fleet of 24 test cars

(as of August 2014), which are modified Toyota Lexus hybrids^[4]. While the car has not yet been on public roads, these 24 cars have 700,000 miles of autonomous driving logged to date.

Several car manufacturers are also pursuing an autonomous car including Audi, Mercedes, Nissan, Toyota, and Volkswagen. However, some auto manufacturers find the vision of an autonomous car contrary to the marketing efforts and value perception. Manufacturers who have a great deal of value attached to the “driving experience” may be concerned that a driverless car will damage their value. BMW, for instance, with a marketing campaign centers on the driving experience, would face significant rebranding in an era of driverless cars.

Other challenges that the autonomous car faces is safety and regulatory concerns. Although initial testing has proven these vehicles to be quite safe (only one minor accident for the Google Driverless Car which was at the other party’s fault), this is a huge leap forward, which will take significant proof to convince regulatory bodies, as well as consumers, of the safety. While proof of safety is a challenge the autonomous car will have to overcome, it is also one of its largest drivers. The autonomous car by design will be safer than human driven cars since human error and distraction, the largest cause of accidents, will not be a factor. Other benefits of the autonomous car include:

- **Accidents:** Fewer traffic collisions, due to an autonomous system's increased reliability and faster reaction time compared to human drivers.
- **Road Capacity:** Increased roadway capacity and reduced traffic congestion due to reduced need for safety gaps and the ability to better manage traffic flow.
- **Higher Speed Limits:** Higher speed limit due to the ability of autonomous cars to react more quickly and better avoid accidents.
- **More Leisure Time:** more leisure time for commuters who can use “driving” time to be productive with email, calls, etc.
- **Widening of Eligible “drivers”:** since the “driver” will not actually be operating the car, those previously unable to drive, those that are disabled, under/over age, intoxicated/impaired, would be able to ride in an autonomous car in instances where they would not be safe otherwise to operate the vehicle.
- **Parking:** Alleviation of parking scarcity, as cars could drop off passengers, park far away where space is not scarce, and return as needed to pick up passengers.

Impact on the Home

Steps are being undertaken to integrate the connected car with the connected home. Developers envision the connected car being able to tap into the home network or Cloud, allowing the car to control the home environment (turn on lights, temperature controls, security systems) or even to access calendars, forecasts, and traffic updates to help drivers better plan their trip. Many companies are engaged in this converged connected car/connected home experience, current initiatives include:

- **Apple:** introducing the app experience that users are familiar with on smartphones, tablets, and PCs to the automotive market through their new initiative CarPlay. Apple's CarPlay will utilize an external device (smartphone) to bring tethered connectivity to the car.
- **Aricent:** introduced a connected car solution that connects a car network to a home and Cloud network over LTE, allowing a driver to monitor and control his home remotely. Aricent's solution is available on Texas Instruments' OMAP™ 5 automotive platform.
- **Denso and Sharp:** collaborating on new technologies that integrate connected vehicles with home electronics in order to improve vehicle comfort, safety and convenience.
- **Ford:** partnered up with Eaton, SunPower, Whirlpool and Georgia Institute of Technology to explore ways to reduce energy consumption and CO₂ emissions by integrating home appliances with plug-in electric vehicles.
- **Mercedes-Benz:** working with Nest Labs to integrate the Nest Learning Thermostat.

Entertainment Applications

While safety features are the near-term driver for connected car technologies, players in the market are betting on entertainment applications as well. Although these applications may not be fully embraced until the market is more mature, entertainment applications are being developed alongside the safety and lifestyle features of connected cars. Among the initiatives currently underway include:

- **AT&T:** AT&T has developed the Drive Studio to develop and test AT&T Drive technologies. In addition to developing safety applications, the mission of the Drive Studio is also to develop new applications and services focused specifically on the car and the end user. AT&T is working with other ecosystem players in the AT&T Drive

initiative including Accenture, Amdocs, Clear Channel's iHeart Radio, Ericsson, Jasper Wireless, Synchronoss and VoiceBox.

- **Ericsson:** Ericsson is working to deliver stored music and information wirelessly to the vehicle, without a phone connection.
- **Google:** Google's Android Auto debuted in early 2014, the connected vehicle infotainment system. The system lets a user with an Android smartphone "cast" apps and content to the system in an extension of its Chromecast functionality for TVs. Special control capabilities have been added to prevent distracted driving, for instance, Google Maps, music functions and texting can all be controlled via voice command, as well as a touchscreen and steering wheel buttons. Features also have a different look when ported to the console—Google Maps, for instance, looks similar to a standard GPS system, and the music interface is typical to car stereo controls.
- **Kia:** Kia, on the Kia BUZZ corporate blog, speaks to advanced entertainment systems for the connected car. They highlight the potentials of an infotainment system, which will take data from the driver's surroundings to provide customized audio and visual entertainment for the driver. For instance, the system has the ability to detect the driver's mood and play the best music for it.

Lifestyle

Another developing feature of the connected car are lifestyle features. These are features that simplify everyday events to improve the users' efficiency and quality of life. Examples include the following:

Parking

Several apps have surfaced for the connected car environment to help drivers locate available parking in close proximity. For instance, AT&T announced in September 2014 a partnership with Streetline's Parker which will be included in AT&T's Drive connected car platform, along with a series of other apps. There is also discussion of a valet park capability where the driver would exit the car at the desired destination and then press a self-park button and the car would independently search for a parking spot and self-park.

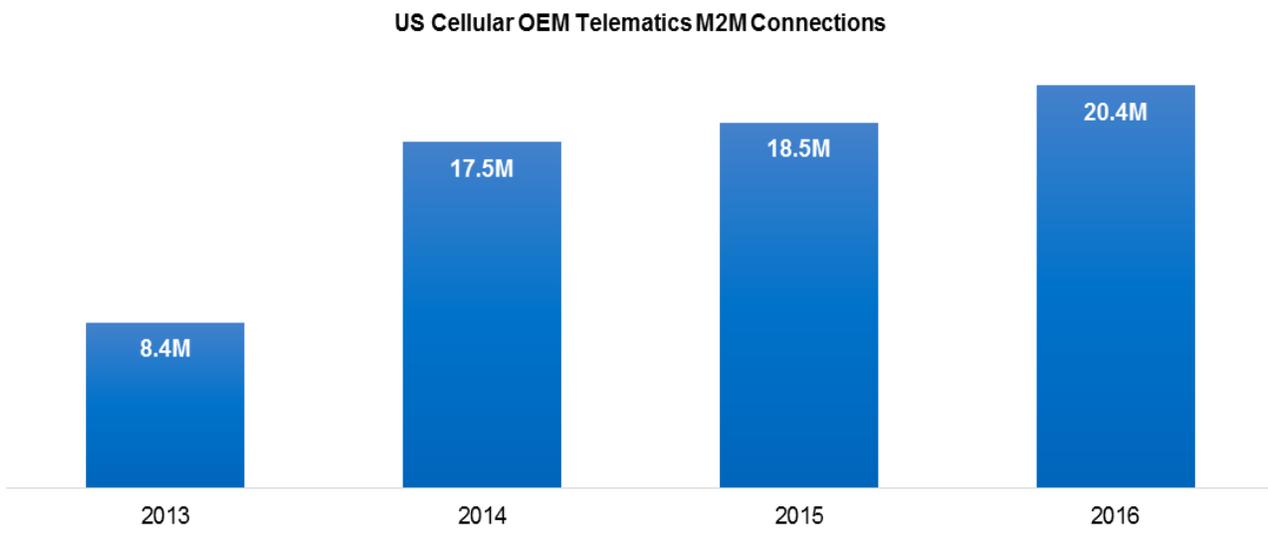
POI

The connected car promises to elevate the basic point of interest capability that GPS apps are currently capable of. These next gen POI apps will notify drivers of venues, but will also post entertainment schedules, notify of incoming trains/flights, allow reservations to be made,

enable take-out orders to be placed, etc. There are also delivery features of such apps...for instance, Volvo demonstrated a new “Roam Delivery” service that allows consumers to have their shopping delivered straight to their cars.

Market Opportunity

The connected car market is at the cusp of significant growth. While the number of connected vehicles currently on the road is quite small currently, it is expected that within the next several years the majority of new cars will ship with some type of connectivity feature (tethered, embedded, or integrated). The following forecast, published by Compass Intelligence characterizes the growth in the U.S. market with wireless connected vehicles.



Source: 2014 Compass Intelligence

Industry Evolution and the Impact for Companies Participating in the Market

Impact on Automotive Companies

Connected cars are a foray into the telecommunications market for automotive companies and thus a departure from the norm. Typically the telecommunications market functions on a much

shorter product cycle. New technologies are introduced, brought to market, and run their course in a relatively quick time frame, whereas the automotive market is much slower moving with product development typically taking years and years. Unifying these two (2) diverse cycles will be a challenge for automotive manufacturers.

Those in the space will also have to deal with the consumer market. When a consumer purchases a car, that individual often owns that vehicle for 5 to 10 years. That car may then transition to second or third owners. During this course of time, the connectivity solution will evolve significantly. With the car having such a long product life, and the connectivity solution so transitional, automotive manufacturers will be challenged by how to manage connectivity updates in post-production cars.

Impact on Connected Home Companies

The connected home market has been slow to develop due to initial high price-points associated with the technologies. Now that prices have fallen to affordable levels, adoption is rapidly growing. Connected home companies now are challenged with the need for devices to speak to one another in order to truly automate the home as one single system. The complexity of this inter-device communication is about to increase as the connected car enters the equation. Not only will connected home devices need to be able to talk to other devices in the home, but users will also want them to be able to communicate with their car. To achieve this end, both connected car and connected home companies will need to work toward standard development and Cloud-capable communication and control.

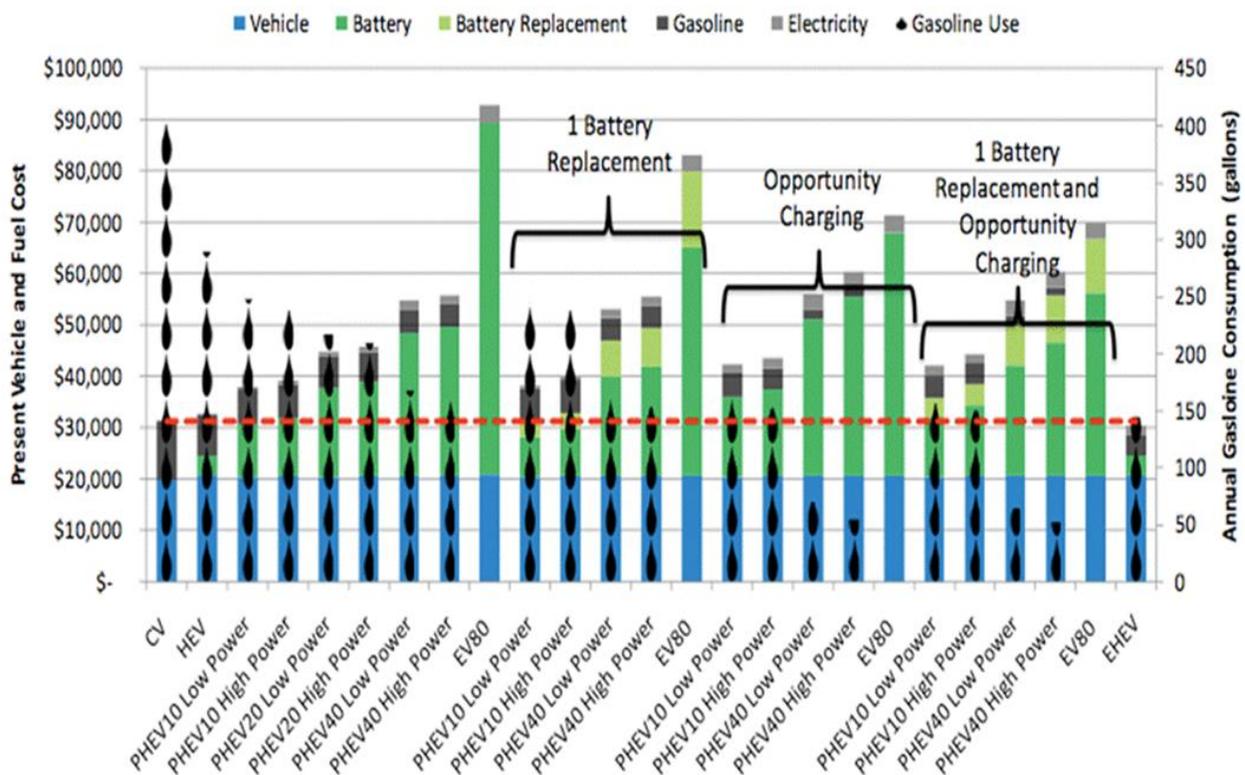
Impact of Electric Cars

Similar to connected cars, electric cars are an innovation in the automotive industry that is making a big impact on consumers' lives. Electric cars have been around since the late 1800s, but in recent times have experienced resurgence in interest due to the environmental benefits. Electric vehicle sales are growing, with an expected three (3) million in vehicle sales worldwide for 2015. Current sales are lead by Nissan Leaf, followed by the Chevy Volt. While further along in product life cycle than connected cars, the electric car market is by no means mature.

There remain significant challenges in the electric car market, principally the recharging of vehicles. Most recharging will occur at home, on specially installed charging stations specifically designed for the vehicle. These charging stations will run 220/240 volts, rather than the US standard 110 volt, reducing the charging time to anywhere from 3.5 hours (Tesla) to 8 hours (Leaf).

Charging stations are also popping up at public places to “top-off” a charge. Public charging stations are either Level 2 or Level 3. Level 2 chargers are similar to those in most residences and account for the majority of public chargers. These Level 2 chargers are run by a charging system network, such as ChargePoint or SemaConnect and to access this power users may need an account with the charging network to use the station. Stations can be found using websites/apps such as Plugshare. Level 3, of DC fast charge, access a 480 volt connection for rapid charging. However, outside California, Level 3 charging stations are pretty rare. Thus, while solutions are emerging to improve the practicality of electric cars, driving these vehicles still requires a good deal of preplanning and strategic recharging.

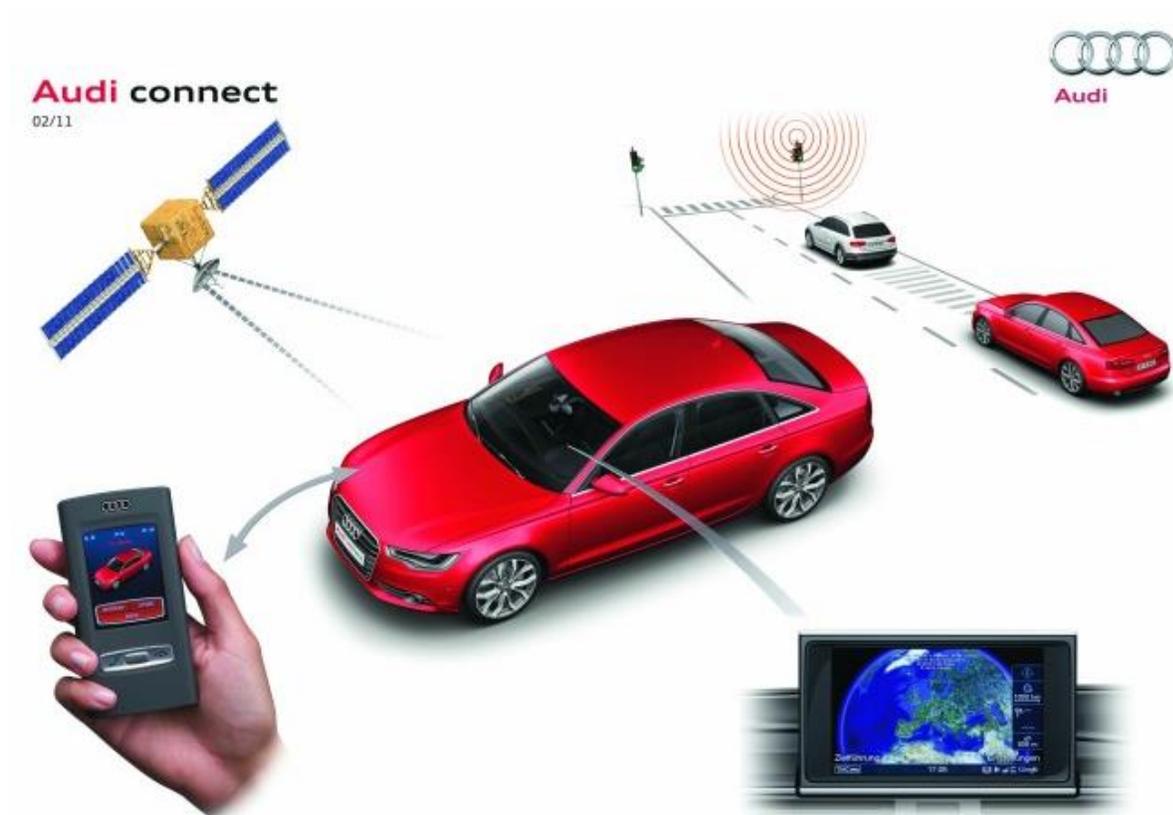
The following chart displays the payback for electric vehicles. This is a metric that potential buyers evaluate when selecting a car.



Source: National Renewable Energy Lab

Case Study: Audi

Audi emerged as an early leader in the connected car market. For the past several years the German auto manufacturer has been at the forefront of the industry in integrating connected car technologies into the automobiles. Recognized by the industry for this leadership role, Audi received the first ever Connected Car of the Year award, presented by Connected World Magazine, in 2012 for the A8 and then subsequently won again in 2013 with the A7.



Audi's connected car product, termed Audi Connect, is a feature-rich connectivity service with navigation, communication, and infotainment features, as summarized in the following chart. Audi Connect is available on the A4, A5, A6, A7, A8, Q5, and Q7^[5]. The A3 introduces additional features to Audi Connect, including social media (Facebook and Twitter), flight information, and personalized news. The 2015 A3 will also feature MMI connect App which allows the driver's smartphone to sync with the in-car MMI navigation in order to provide enhanced navigation and infotainment features.

	A4	A5	A6	A7	A8	Q5	Q7	A3
Navigation & mobility								
SiriusXM Traffic	0	0	0	0	0	0	0	0
Navigation with Google Earth	0	0	0	0	0	0	0	0
Google Maps Street View	0	0	0	0	0	0	0	0
Picture navigation								0
myAudi Destinations	0	0	0	0	0	0	0	0
Google Voice Local Search	0	0	0	0	0	0	0	0
Map update via SD card								0
Parking information	0	0	0	0	0	0	0	0
Fuel prices	0	0	0	0	0	0	0	0
Flight information								0
Communication								
Facebook								0
Twitter								0
Infotainment								
Audi music stream	0	0	0	0	0	0	0	0
Weather	0	0	0	0	0	0	0	0
Travel Information	0	0	0	0	0	0	0	0
News	0	0	0	0	0	0	0	
Personalized news								0
City events	0	0	0	0	0	0	0	0
Google Local Search	0	0	0	0	0	0	0	0
Wi-Fi hotspot	0	0	0	0	0	0	0	0
3G	0	0	0	0	0	0	0	
4G/LTE								0

Source: 2014 Compass Intelligence

The A3 is also connected via 4G/LTE. Audi was the first to bring to market LTE connectivity for the car, announcing the capability in July 2013. Previously connecting Audi vehicles via T-Mobile 3G, Audi switched telecom partners in the first quarter of 2014, transitioning to AT&T's Drive LTE offering. AT&T Drive is the mobile operator's connected car platform that allows automakers to choose those services and capabilities that best meet their brand and consumer needs. Audi debuted AT&T Drive in the 2015 A3 sedan, but then announced in September 2014 that the 2015 Q3 would also offer this capability. Enabled Audi models can connect to AT&T's network via its Mobile C\Share Value plans for \$10 per month.

Audi has struck a variety of important technology partnerships. The company is a member of the Open Automotive Alliance, announcing membership at CES 2014. The Open Automotive

Alliance is a coalition of automotive and technology companies that plan to offer Android-based infotainment late in 2014. Audi has also partnered with Google-rival Apple in developing the iOS Car platform.

Despite their lead position in the connected car market, Audi continues to be heavily involved in research to continue to evolve the connected car concept. Partnering with universities and other research organizations, Audi is active in exploring future connected car applications and potentialities. Among the projects the company is involved in include:

- The Audi Urban Intelligent Assist research project is striving to make urban commutes less stressful by analyzing environmental data and studying each driver's schedules, habits and preferences.
- Audi is working with MIT to study driving behaviors and driving stressors. Using real-time driver and environmental data, such as road conditions and heart rate, the study seeks to quantify the factors that lead to driver stress. The findings from this research will help inform how current and future connected car technology can ease driver frustration on the road.
- Audi is also working with MIT in the HubCab project in New York City, which will track over 150 million taxi trips in NYC to gain insight on ride share. Insights will inform researchers on how car-sharing systems can lower vehicle emissions, reduce congestion, and save money and time.
- In July Audi was the first to test a highly automated car on Tampa's Selmon Expressway, a stretch of roadway that is designated as a technology test bed.

Final Word

The connected car market is on the cusp of significant growth. A variety of market factors, from government regulations, to industry partnerships, to consumer demand, are propelling the connected car market forward. Consumers got a glimpse of the future of connected cars in 2014 as select models began rolling off the production line with these capabilities, but 2015 promises so much more in terms of number of connected vehicles and the services being delivered to those vehicles.

But challenges exist. This is a new era in a highly regulated industry and safety of the gamut of connected car solutions must be tested. Furthermore, as connected cars are a cross-industry

initiative, auto manufacturers must incorporate industry standards and consumer expectations for mobile products into their car design. However, as the Audi case study exemplifies, auto manufacturers in many instances are deeply embracing the concept of connected cars and are investing in the research and development that will bring to consumers the connected cars they have been dreaming of.

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