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The Automotive Sector and AI

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The Automotive industry: a brief overview

- ## Scope, size and key trends

The automotive industry includes a wide range of companies and organizations involved in the design, development, manufacturing, marketing, and selling of motor vehicles. It is one of the world's most important economic sectors by revenue and is a key sector of the economy for every major country in the world.

The automotive industry is more than 100 years old and it is still a major innovator, investing over 93 billion USD in research, development and production. In Europe alone, the automotive industry accounts for roughly 12 million jobs (including related jobs); in the US, more than 8 million; and in Japan, more than 5 million.

The term automotive was created from Greek "*αὐτός*" (self), and Latin "*motivus*" (of motion) to represent any form of self-powered vehicle. It pointed out at that time revolution: the horse-less carriage.

Nowadays, thanks to progress in Artificial Intelligence we are facing one of the next step of automotive evolution : it's the dawn of the driver-less car.

Other key trends in the automotive sector are driven by AI and other emerging new technologies.

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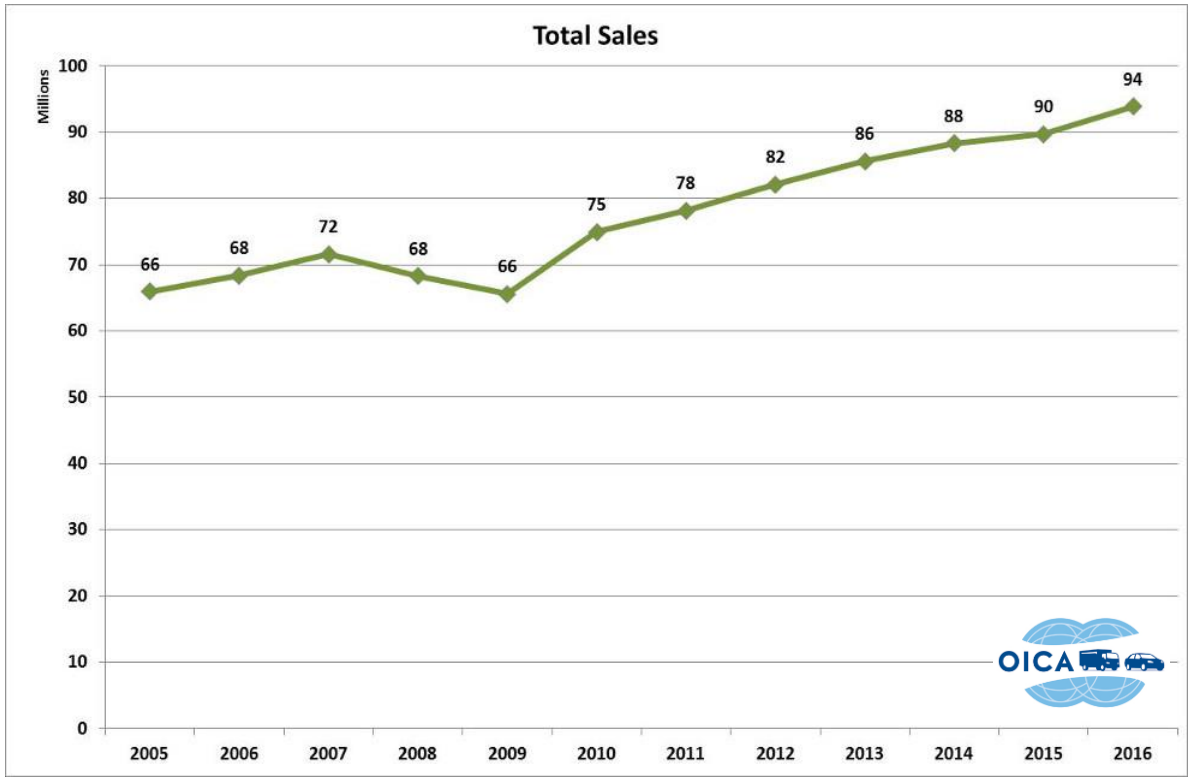
All vehicles worldwide sales statistics



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Production statistics by country (2016)

Country	Passenger Cars	Commercial Vehicles	Total	% change
Total	**72,105,435**	**22,871,134**	**94,976,569**	**4.5%**
China	24,420,744	3,698,050	**28,118,794**	14.5%
USA	3,934,357	8,263,780	**12,198,137**	0.8%
Japan	7,873,886	1,330,704	**9,204,590**	-0.8%
Germany	5,746,808	315,754	**6,062,562**	0.5%
India	3,677,605	811,360	4,488,965	7.9%
South Korea	3,859,991	368,518	4,228,509	-7.2%
Mexico	1,993,168	1,604,294	3,597,462	0.9%
Spain	2,354,117	531,805	2,885,922	5.6%
Canada	802,057	1,568,214	2,370,271	3.8%
Brazil	1,778,464	377,892	2,156,356	-11.2%
France	1,626,000	456,000	2,082,000	5.6%
Thailand	805,033	1,139,384	1,944,417	1.8%
UK	1,722,698	93,924	1,816,622	8.0%
Turkey	950,888	535,039	1,485,927	9.4%
Czech Rep.	1,344,182	5,714	1,349,896	8.3%
Russia	1,124,774	179,215	1,303,989	-5.4%
Indonesia	968,101	209,288	1,177,389	7.2%
Iran	1,074,000	90,710	1,164,710	18.6%
Italy	713,182	390,334	1,103,516	8.8%
Slovakia	1,040,000	0	1,040,000	0.1%
Others	781,708	138,454	920,162	10.6%
Poland	554,600	127,237	681,837	3.2%
South Africa	335,539	263,465	599,004	-2.7%

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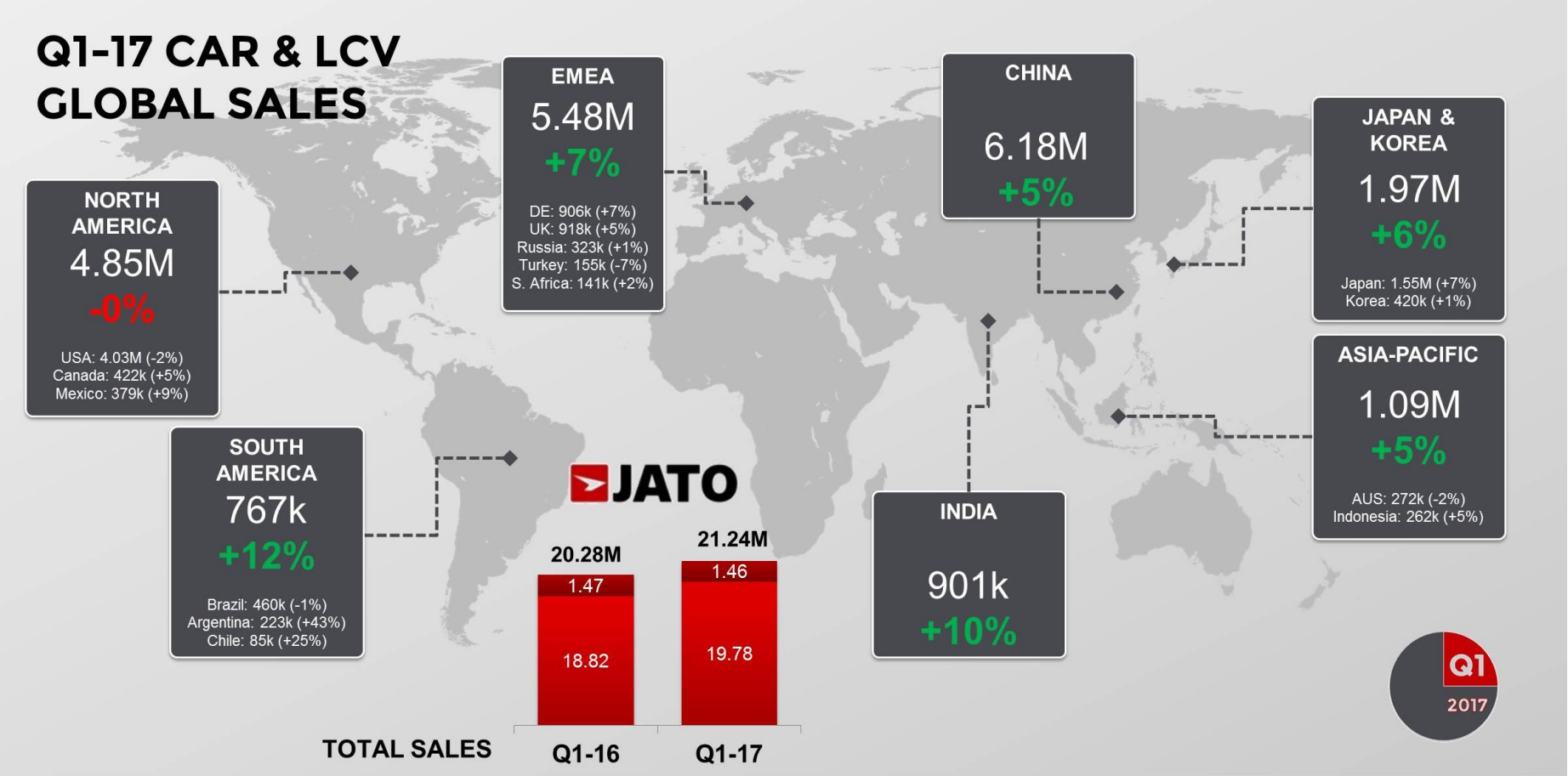
Sales statistics by area (Q1-2017)



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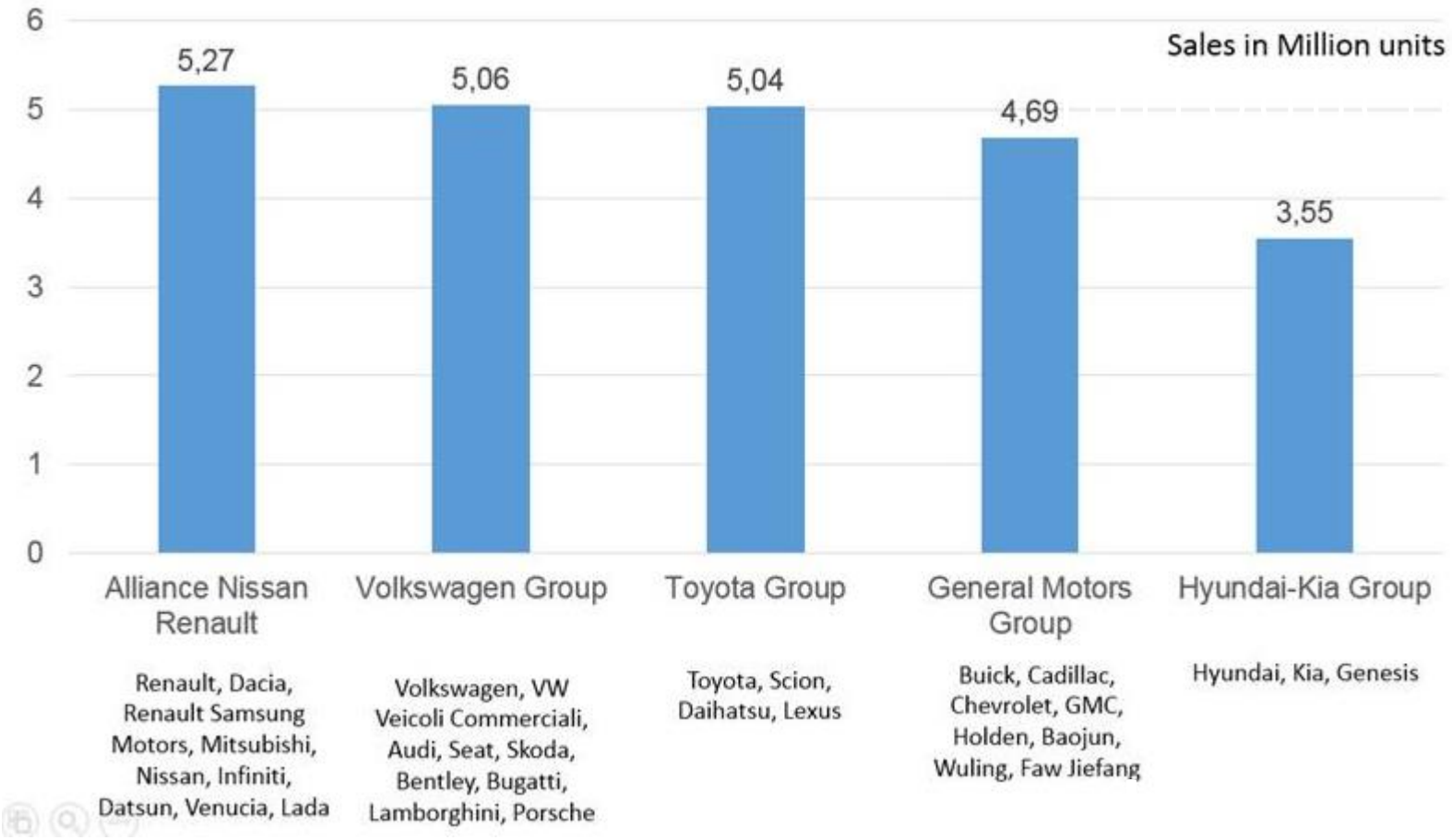
Global sales by manufacturers in H1 2017



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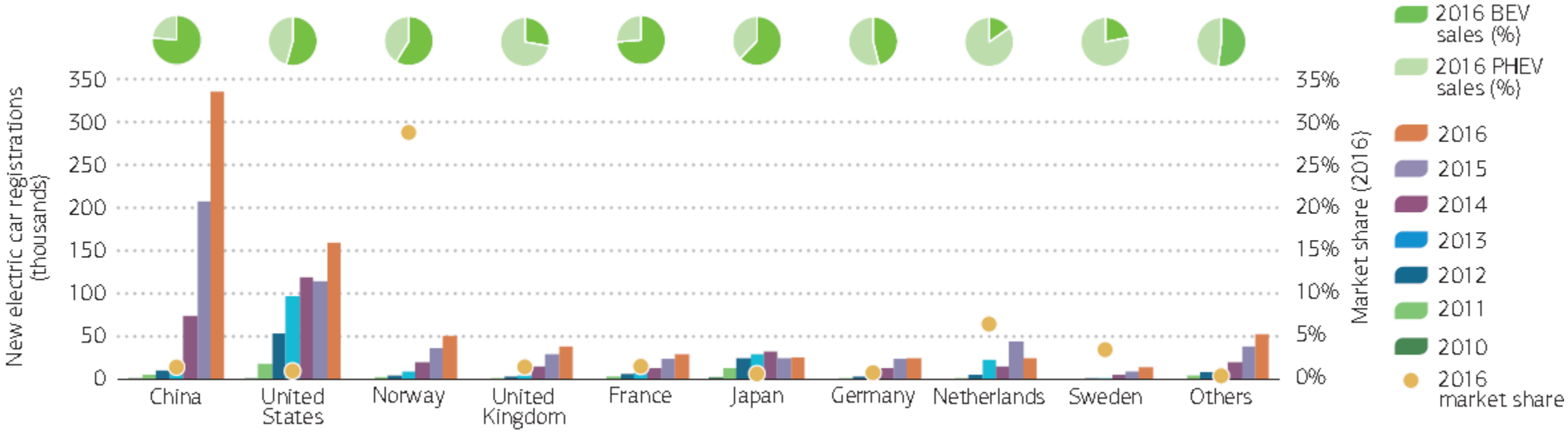
Electric cars sales



The two main electric car markets are China and the United States. Six countries have reached over 1% electric car marketshare in 2016: Norway, the Netherlands, Sweden, France, the United Kingdom and China.

International Energy Agency
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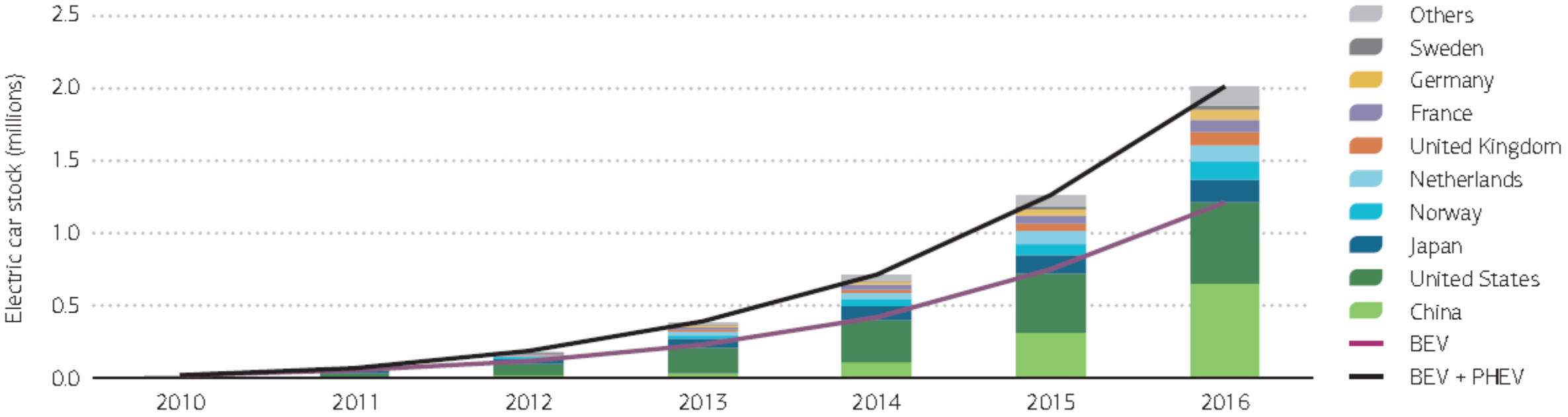
Evolution of the global electric car stock, 2010-16



The electric car stock has been growing fast since 2010, with a fairly consistent distribution of BEVs (60%) and PHEVs (40%) across the years. 80% of the electric cars on road worldwide are located in China, the United States, Japan, Norway and the Netherlands.

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Technology-driven trends impacting on automotive

How new AI-fueled vehicles may look like in the future ?

- Smart :
  from assisted features to full autonomous driving
- Connected :
  from infotainement to V2V - V2I - V2X connectivity and on-demand mobility services
- Electrified :
  from ICEV to 100% EV and V2G applications

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Triggering AI power into mobility

Current evolution towards autonomous driving

The past: horse-less carriage

The present: assisted driving

The future: driver-less car

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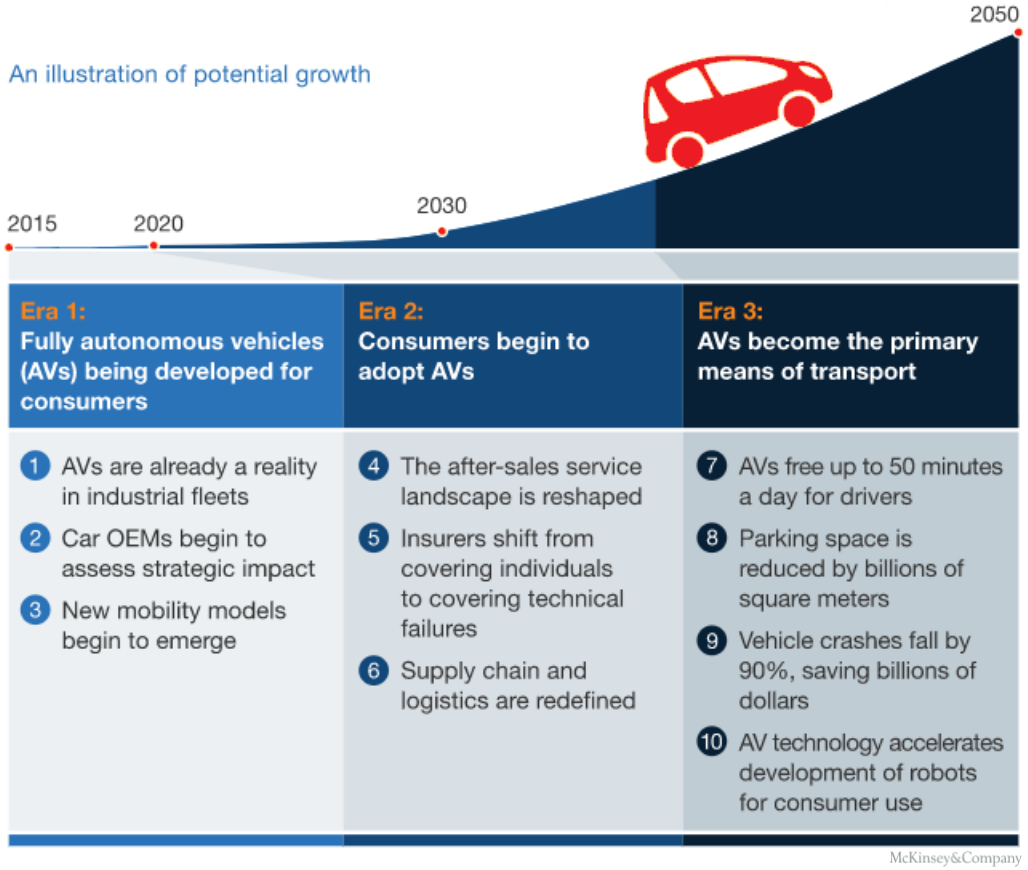
The rise of Autonomous Vehicles



An autonomous vehicle is capable of sensing its environment and navigating without human input. Many such vehicles are already being developed, but as of today automated cars permitted on public roads are not yet fully autonomous. They all require a human driver at the wheel who is ready to take control of the vehicle immediately at any time.

Autonomous Vechicles use a variety of sensors and techniques to detect their surroundings, such as radar, laser light, GPS, odometry, and computer vision. Sensory data is fused and interpreted with algorithms shaped by machine learning AI.

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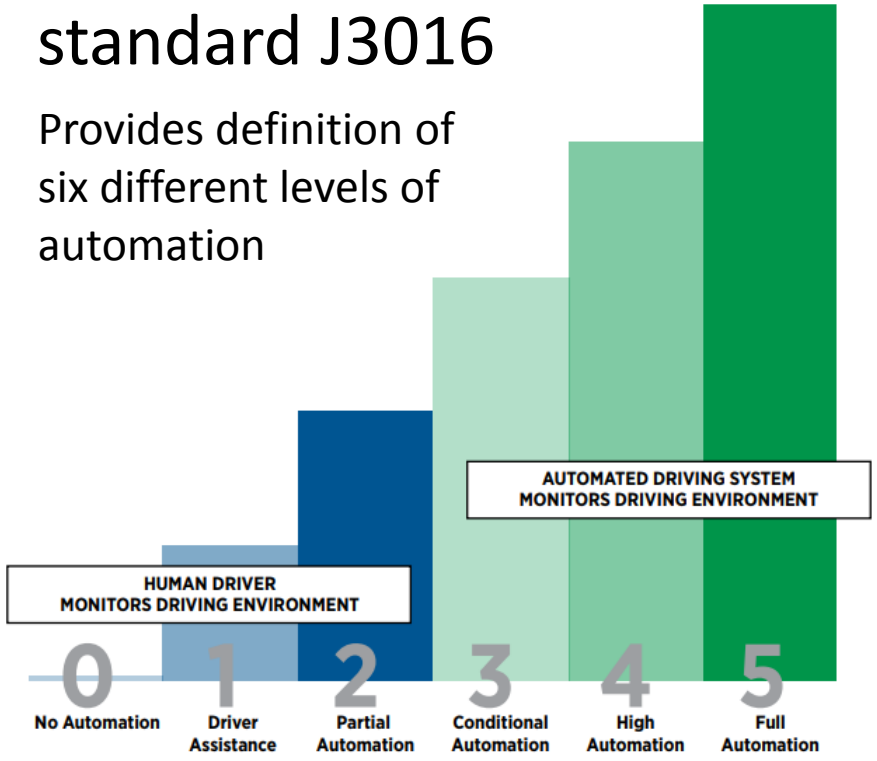
SAE Automation levels

standard J3016

Provides definition of six different levels of automation

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/ Deceleration	*Monitoring* of Driving Environment	Fallback Performance of *Dynamic Driving Task*	System Capability *(Driving Modes)*
***Human driver* monitors the driving environment**						
0	No Automation	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	Driver Assistance	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	Partial Automation	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
***Automated driving system* ("system") monitors the driving environment**						
3	Conditional Automation	the *driving mode*-specific performance by an *automated driving system* of all aspects of the dynamic driving task with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	High Automation	the *driving mode*-specific performance by an automated driving system of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	Full Automation	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**



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Social and economical opportunities of autonomous drive technologies

Goldman Sachs projected **the market for advanced driver assistance systems and autonomous vehicles** would grow from about USD 3 billion in 2015 to 96 billion in 2025 and 290 billion in 2035.

Economic analysis from an independent report carried out in Europe shows that autonomous vehicles will start adding **0.15 percent to Europe's annual growth rate in the decades to come**. As a result, the European (EU-28) gross domestic product will, cumulatively, be 5.3 percent higher in the year 2050 than currently, by which time autonomous vehicles will have contributed to GDP with a total of EUR 17 trillions.

The study revealed that **the vulnerable in society have most to gain from autonomous drive technologies**, with disabled people (57 per cent), the elderly (34 per cent) and the visually impaired (33 per cent) mentioned by the majority of survey respondents. With a growing elderly population, autonomous vehicles could provide a renewed sense of freedom through increased mobility.

Survey respondents also saw multiple **benefits for** their **health and well being** too : safety is the main perceived concern, with expected **fewer car accidents, lower stress levels and more free time** by reducing time spent navigating stressful road situations.

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Emerging on-demand mobility services

While Autonomous Vehicles are being developed, a variety of other transport-mobility innovations are already available on the road, as the result of consumers' new habits.

Individuals increasingly use multiple modes of transportation to complete their journey and a shift is occurring from personally owned modes of transportation towards mobility solutions that are consumed as a service.

A myriad of innovative solutions in the form of on demand services are flourishing, such as car sharing, carpooling, e-hailing taxi alternatives, and peer-to-peer car rentals. They are attracting investments and seeing impressive growth rates. Carmakers are investing in this new business model too. Car2Go, the largest car sharing company in the world, is a subsidiary of Daimler. Nissan launched MOV-E, in partnership with ENEL, a platform delivering corporate car sharing services and implementing vehicle to grid (V2G) technology.

When used for car sharing, the total number of cars is reduced. Autonomous Vehicles will push the trend further, since the robotic car can drive unoccupied to wherever it is required, such as to pick up passengers.

As a result, the traditional business model of car sales will be complemented by a range of diverse, on-demand mobility solutions, especially in dense urban environments that proactively discourage private-car use.

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AI-fueled connectivity

Autonomous Vehicles won't be smart enough until they are capable of **exchanging information between themselves, with the infrastructures and the IoT environment**. By implementing communication networks both in proximity (for collision avoidance) and remotely (for traffic and parking management), autonomous vehicles can start deliver all their potential, being not only interconnected but also **cooperative**.

Connectivity makes **platooning** possible, by coupling of several vehicles within minimal distance of each other, so that they automatically and simultaneously accelerate or brake with benefits in terms of **reduced congestion and fuel economy** (due to reduced air resistance). Smart vehicles with AI can automatically join and leave platoons.

With the help of AI modern vehicles equipped with sensors and on-board parking cameras could determine the location and size of an empty parking spot just by driving past. This information could be distributed via the internet, allowing the creation of a **real-time overview of city parking spaces** and thereby better traffic management and parking in cities.

Connectivity also provides analytics that insurers can use to **improve risk assessment** and create more individualized insurance plans. The benefit of the deep-learning AI analytics platform is already being realized with certain fleet management companies that have reported safer driving among their connected fleets, with reduced accidents and **lower insurance premiums**.

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Increasing presence of technology firms in the automotive industry

The technology necessary to make connected and intelligent vehicles - sensors, networking, software - is not in the traditional area of expertise of most automakers.

That shortcoming is an invitation to high-tech companies, such as Google or Apple for instance, to get into a market that has significant growth opportunities.

Big high-tech players are making moves to develop or acquire the technologies which are the building blocks of the next generation vehicles.

One of the biggest acquisitions registered in this sector in 2017 was the takeover by the giant U.S. chipmaker Intel of Israeli autonomous vehicle technology firm Mobileye for USD 15.3 billion. Mobileye brings a broad portfolio that includes cameras, sensor chips, in-car networking, roadway mapping, machine learning, cloud software and data fusion and management. It accounts for 70% of the global market for driver-assistance and anti-collision systems and supplies integrated cameras, chips and software for driver-assist systems to more than two dozen vehicle manufacturers .

Car producers are entering into strategic alliances or making direct investments in the key high-tech companies, with the latter ones expected to exert a growing influence in the automotive sector.

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Electrification trend

Stricter emission regulations, lower battery costs, more widely available charging infrastructure, and increasing consumer acceptance will create new and strong momentum for penetration of electrified vehicles (hybrid, plug-in, battery electric, and fuel cell) in the coming years. Adoption rates will be highest in developed dense cities, but will spread as soon as the range of Electric Vehicles improves.

Analysis predicts that the total cost of ownership of Electric Vehicles will dip below those with Internal Combustion Engines in 2022.

All big automotive players are targeting at zero-emission mobility and are progressively increasing their EVs offer, while keeping on developing their traditional ICEVs offer by applying, for instance, exhaust aftertreatment and recovery of energy from waste heat technologies to reduce emissions and improve fuel economy.

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Electric motor efficiency compared to Internal Combustion Engine

In terms of direct **tank-to-wheel efficiency**, which tells you how efficiently your engine turns fuel into movement, **electric engines** can operate providing **up to 95% efficiency over its entire RPM band**, **whereas ICEs efficiency vary** over the range of speeds between 0%, when idle, **up to 35%, with an average efficiency of a normal gasoline car being 16%**. Total EV round-trip efficiency drops to about 70% if we consider the power conversions operated by the inverters from AC (home charger) to DC (battery power) and back to AC (electric engine). Yet, **an electric car is over four times as efficient at turning energy into motion.**

In terms of **well-to-wheel efficiency** the comparison depends on where electricity comes from. The mix of generation sources (coal, gas, nuclear, renewables) to be considered varies across countries. But **efficiency is significantly higher in power plants, where sophisticated waste heat recovery systems are applied in combined cycle generators. In ICEVs most of the energy is lost as heat.**

Power plants are also cleaner at emissions than ICEVs due to their scale and sophisticated treatment technologies.

The complete life cycle comparison also shows better energy efficiency in EVs than in ICEVs.

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Exchanging energy in the future smart cities :

- From centralized to distributed

Electric power supply, especially by renewable energy, will be increasingly distributed rather than centralized.

Vehicle-to-Grid, Vehicle-to-Home and Vehicle-to-Office technologies

Smart grids will be fed increasingly with variable sources of energy, like solar and wind power production that is intermittent and unpredictable.

Wide EVs diffusion will provide a huge electric storage network that can be used for its balancing and reserve capacities of the power grids, that are affected by peak loads.

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- # Vehicle to Grid (V2G) technologies

Plug-in Electric Vehicles (PEVs) offer users the opportunity to sell electricity stored in their batteries back to the power grid, thereby helping utilities to operate more efficiently in the management of their demand peaks.

A vehicle-to-grid (V2G) system would take advantage of the fact that most vehicles are parked an average of 95% of the time. During such idle times the electricity stored in the batteries could be transferred from the PEV to the power lines and back to the grid. In the U.S the value to the utilities of this transfer back to the grid have been estimated of up to USD 4,000 per year per car.

In a V2G system it would also be expected that battery electric (BEVs) and plug-in hybrids (PHEVs) would have the capability to communicate automatically with the power grid to sell demand response services by either delivering electricity into the grid or by throttling their charging rate.

Nissan, in partnership with Enel, launched in Denmark the first fully commercial V2G hub worldwide. Thanks to V2G technology, when the vehicles are stationary, the car batteries inject power into the network, helping to stabilise it and offering grid balancing services to Transmission System Operator Energinet.dk, in return for remuneration.

Similar pilot V2G infrastructures have been already launched by Nissan in other countries.

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An example from the industry : Nissan perspective

- Why Nissan ?

Because we are in Japan, and Nissan Motors Corporation perfectly represents among other Japanese companies the culture of excellence when it comes to motor vehicles manufacturing.

In the first half of this year 2017 Renault-Nissan Alliance, with its new partner Mitsubishi Motors, sold 5,268,079 vehicles, taking the lead on the global vehicle sales. The Alliance is set to launch over ten vehicles with autonomous drive technology by 2020.

Moreover, the same Alliance cumulatively sold 481,151 electric vehicles, re-affirming its leadership in zero-emission mobility.

Nissan Leaf is the worldwide Electric Vehicle best-seller, with more than 280.000 units sold. Nissan also sold more than 70,000 e-NV200 electric vans, leading the freight logistics sector.

Last but not least, Nissan developed a comprehensive long-term vision on the concept of Intelligent Mobility which is worth to look at in relation to the AI topic and in the light of an investigation on the key trends of the automotive sector related to energy.

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INTELLIGENT POWER
INTELLIGENT DRIVING

Regulatory and security challenges

Smart cars and smart cities need a **common legal framework and harmonised regulations** in order to operate safely and efficiently.

Safety in the automotive industry is particularly important and therefore highly regulated. Motor vehicles have to comply with a certain number of norms and regulations, whether local or international, in order to be accepted on the market. The **standard ISO 26262**, is considered as one of the best practice framework for achieving automotive **functional safety**.

The technical requirements as well as **international traffic rules** are agreed at **United Nations** level and are currently in the process of being assessed with a view to the increasing automation of vehicles.

Policy makers, in particular, face challenges in designing the appropriate legal and regulatory framework so that new technologies are used properly and for the benefit of society.

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Key issues

Traffic rules need to be amended, driving licensing adapted, data protection and cyber security has to be secured, and liability issues solved for the deployment of Autonomous Vehicles.

New rules need to be adopted on how Autonomous Vehicles safety has to be tested.

Technical standardisation is necessary for international compatibility and interoperability.

Specific new regulatory frameworks are required in order to implement the V2G applications.

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Thank you for your attention !

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