

# Connected (e-)mobility

## Fact sheet for innovation fields

### Mobility is becoming electric, connected and autonomous

- Decarbonization, reduction of fine particulate matter, less noise, lower accident rates and, above all, traffic that flows instead of jams, particularly in megacities – these are just a few of the reasons why researchers are busy developing mobility concepts of the future.
- Self-driving vehicles and driverless subways that bring people to work, their homes and schools in perfect synchronization – the future of mobility has already arrived. Many start-ups have taken on the challenge of mobility as a new business area and are moving development forward, particularly in the United States, China and Great Britain.
- The advances being tested today by researchers in pilot projects, on proving grounds and in model cities will soon become on-the-road realities – and many experts assume that these changes could be fundamental, if not disruptive. Many ideas still in the test or concept phase right now could very quickly conquer the market and sweep aside current mobility systems in the process. In light of this, it is crucial to keep pace with the times. This is the reason Siemens' new next47 unit will devote itself to this innovation field and work with start-ups to create the innovative solutions of the future. With this in mind, potential fields of activity for the unit may include:
  - Further digitalization of mobility
  - Cloud-based applications for mobility management across all means of transportation
  - X2X communications as a data source for smart traffic management
  - Sharing models
  - Further development of electric and autonomous driving

### Top priority: Tomorrow's charging infrastructure

- Development of the charging infrastructure has advanced to the top of the to-do list of many industrial countries, particularly in Germany, which is determined to lead the effort to expand electric mobility.
- Siemens is conducting research on technologies that will facilitate the fast, safe charging of batteries and on programs to manage charging infrastructures. The first pilot projects have already made the transition to commercial use.
- Working with partners from the automotive industry and energy production, Siemens has installed eight direct-current, fast-charge stations along the A9 autobahn between Munich and Leipzig and set up the stations' associated infrastructure. The company's experts tested not only the operation of the direct-current, fast-charge stations, but also the software used for managing the charging process and integrating the charging stations into the IT systems of the energy provider. This facilitated the practical use of electromobility over a long distance for the first time.

- In the United States, Siemens is testing fast, uncomplicated charging with a system it developed that can be brought to the electric car itself. Working with California start-up FreeWire, Siemens studied how mobile charging stations would have to be managed so that drivers could use them.
- Stockholm, Gothenburg, Hamburg – electric-hybrid buses that use roughly 80 percent less energy than diesel buses and thus measurably improve air quality in these cities. The buses were made by Volvo, and Siemens supplied the charging technology for the terminal stations. The electric motor used by the buses has a maximum output of 150 kilowatts (kW) and can be used on a nearly unlimited basis for normal operations thanks to the repeated charging option at the final stop of each route. The motors draw their power from lithium-ion batteries. Fast-charge stations with output of up to 300 kW recharge the batteries within six minutes. Another new addition is the inverse pantograph used in the system. It is now part of the charging station itself and not part of the bus. The pantograph is lowered to the roof of the bus and then transmits power to the battery.
- Start-ups have been exploring charging technologies for many years now: A company called ChargePoint is connecting public charging stations in the United States with the help of cloud software. Siemens is one of the investors in the company along with BMW. A European start-up (in which Siemens has not invested) is working to make charging stations at private homes accessible to the public. Members of a charging community will be able to use the stations at lower rates than nonmembers. Other start-ups, some backed by major corporations, are exploring the idea of wireless charging. This is also an option that has been researched by Siemens CT. Siemens plans to work with start-ups to step up its efforts in this area.

#### Needed: New technologies and infrastructures for autonomous driving

- Autonomous driving has been a key focus of major mobility players, both new and old, for a considerable time. In April 2016, for instance, Google, Ford, Volvo, Uber and Lyft set up a lobbying group that will work to speed up the introduction of self-driving cars. Volvo is planning to deliver up to 100 semiautonomous cars to London and Gothenburg by 2018. The cars will be designed to take their passengers to their destinations without a human driver. The vehicles will request that a human driver take over only if the car's system determines that driving conditions may be too hazardous because of poor weather. If the human driver does not take control, the car will stop. General Motors has acquired a start-up called Cruise that develops new technologies for autonomous driving.
- Siemens researchers are also thinking far into the future of self-driving vehicles. Autonomous taxis and small buses could cover the "last mile" between a person's home and the train station – private cars would become largely superfluous in cities, significantly reducing the amount of traffic. Requirements for this change will include a new type of transportation infrastructure that transmits all necessary information directly to autonomous vehicle. Siemens is already working with municipal officials, public transportation operators and research institutes to develop such traffic concepts.
- The automation of rail systems is also well advanced: Driverless subway trains made by Siemens demonstrate every day in Nuremberg, Barcelona, Paris and Budapest that their Wi-Fi-based control systems can transport more passengers in the same amount of time than conventional subways. This process requires precise timing, where the braking distances and speeds of the trains are constantly calculated, as is the shortest-possible distance to the next train. At the same time, each train's control system uses its route profile to determine how much the train must accelerate in order to maintain the distance to the train ahead of it using as little energy as possible.

### Car2X communication: Replacing human senses

- The digital networking of the road transportation system is well under way. The more tasks a car's digital autopilot performs with the help of sensors, communication with other vehicles, transportation infrastructure and traffic control centers, the lower the risk of accidents caused by humans.
- As part of "Car2X," a joint project with the German automotive industry and research institutes, Siemens is exploring how traffic reports or notifications about congestion and accidents can be transmitted directly to vehicles by traffic control centers.
- The company is delivering hardware and software – including roadside units – for use in vehicle communication in the Netherlands, Germany and Austria. In future years, parking garages are to be integrated into Car2X in addition to traffic and warning signs.
- A number of start-ups with which Siemens would like to work more closely with the help of its new next47 unit are working to determine how semiautonomous driving will function in the near future. The professional world is very interested in determining how new camera solutions can make driving safer by enabling cars to automatically apply their brakes when danger appears.