move

MOBILITY OF THE FUTURE

Photo: David Becker / Unsplash

HOW WILL WE BE DRIVING TOMORROW?

The next few decades will be a major challenge for the mobility sector.

Today, road traffic depends almost entirely on fossil energy. By 2050, it should be powered solely by renewable energy. Our vehicles are thus becoming more climate-friendly.

However, they are also becoming more autonomous. Passive safety measures have already made modern cars much safer than they used to be. Nevertheless, every accident is one too many. Autonomous and automated vehicles have the potential to prevent accidents as far as possible.

Photo: Empa

MOVE PAVES THE WAY FOR THE MOBILITY OF THE FUTURE

move is Empa's future mobility demonstrator. Together with partners from research, industry and the public sector, new mobility concepts are being implemented and operated in move since its inauguration in 2015.

move complements the research performed in Empa's laboratories. The focus lies on electric and hydrogen mobility as well as on vehicles powered by synthetic fuels.

SELF-DRIVING CARS

move is also a research platform for investigations of sensor behavior in a real-world environment. Sensors are a core element for autonomous vehicles.

More information: move.empa.ch

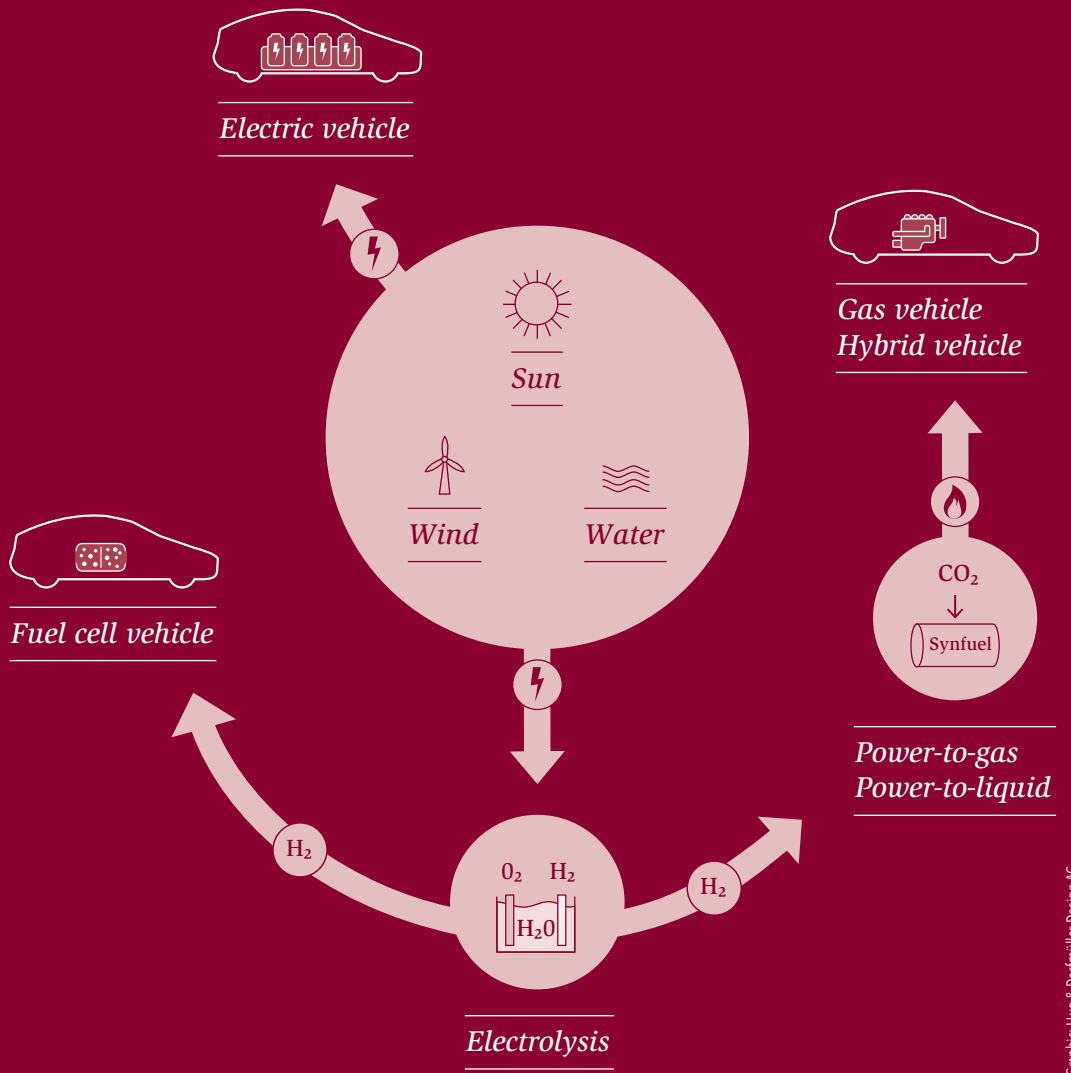
THE MOBILITY OF THE FUTURE IS CLIMATE-NEUTRAL

RENEWABLE ENERGY INSTEAD OF FOSSIL FUELS

Road traffic is responsible for around one third of the CO_2 emissions in Switzerland. These emissions can be reduced massively by switching to renewable energy.

MOBILITY SUPPORTS THE ENERGY TURNAROUND

Renewable energy is only available at certain times: While surpluses are produced on sunny summer days, there are supply gaps during winter. By storing surplus energy in the form of hydrogen or synthetic fuels, the mobility sector can contribute to the summer-winter balance and thus support the energy turnaround.



DRIVING MULTILANE

Once, the internal combustion engine was the "best" solution for all needs. Today, we have to think more thoroughly.

- For short and medium distances – such as inner city travels and commuting –, cars with electric motors are the best option.
- Hydrogen and synthetic fuels are suitable for longer distances.
- Long-distance cargo transport could be achieved with the help of synthetic fuels.

One thing is crucial, though: The energy for all these drive systems has to be based on renewable sources. Only then can the contribution of mobility to global warming be reduced.

Photo: Empa

RUNNING ON ELECTRICITY

70 percent of typical daily trips with passenger cars are shorter than 50 kilometers. In the future, such distances should be driven electrically.

Electric vehicles use solar and wind power most efficiently. However, electricity can only be stored for a few hours and only be transported to a limited extent. Thus, electric vehicles contribute little to the flexibility of our energy supply.

FACTS & FIGURES MOVE

Charging station: 22 kW
Stationary energy storage:
Molten salt batteries and inverters
Capacity: 68 kWh
Power output: 66 kW

THIS IS HOW HYDROGEN IS PRODUCED

Hydrogen for mobility is produced by electrolysis. In this process, water is split into its components O_2 (oxygen) and H_2 (hydrogen) by means of electricity.

Hydrogen mobility is less efficient than electric mobility as the conversion leads to energy losses. However, hydrogen production offers the opportunity to make better use of surplus electricity and to store sustainable energy for weeks.

Photo: Empa

RUNNING ON HYDROGEN

In many countries, the network of hydrogen filling stations is expanding. In Switzerland, there are currently only a few filling stations in operation, but the expansion is progressing fast.

Fuel cell vehicles offer long driving ranges and rapid refueling. They are well suited for long-distance trips.

FACTS & FIGURES MOVE

Electrolysis output: 180 kW_{el}
Max. H_2 production: 2.7 kg / h
H_2 storage capacity: approx. 100 kg
H_2 refuelling pressure: 350 & 700 bar
Required amount of H_2 per tank filling (PC): 2-6 kg
Refuelling duration: 2-3 min

Photo: Empa

THIS IS HOW SYNTHETIC FUELS ARE PRODUCED

Renewably produced hydrogen and CO_2 from the atmosphere can be used to produce synthetic fuels – so-called synfuels –, which can be used in conventional (hybrid electric) vehicles.

During the production of syngas and synfuel, around half of the energy is lost due to chemical conversion, but the synthetic fuels can be stored for months and transported over long distances. Synfuels thus offer the greatest flexibility in using green electricity for mobility.

RUNNING ON SYNTHETIC FUELS

Synfuels can be used in vehicles with a gasoline, diesel or gas-powered (hybrid electric) powertrain. They burn in a climate-friendly manner: The emitted CO_2 had been extracted from the atmosphere and fed into synfuel production beforehand. This process thus closes the carbon cycle.

USING EXISTING INFRASTRUCTURE

Synfuels and syngas can be mixed with gasoline, diesel or natural gas/biogas as required. The switch to renewable fuels can, therefore, take place continuously and without technological rifts.

FACTS & FIGURES MOVE

A project for the production of synthetic methane to be used in gas vehicles has started in 2020. The synthesis of methane from hydrogen and CO_2 is based on a process developed at Empa.

THE MOBILITY OF THE FUTURE IS SAFE

SMART VEHICLES INCREASE ROAD SAFETY

Intelligent vehicles monitor their environment with sensors and support the driver with assistance systems. In future, this will help prevent accidents to a large extent.

In a digitalized road traffic system, vehicles will also be able to drive themselves. By communicating with traffic control systems, they will reduce the risk of traffic jams and accidents.

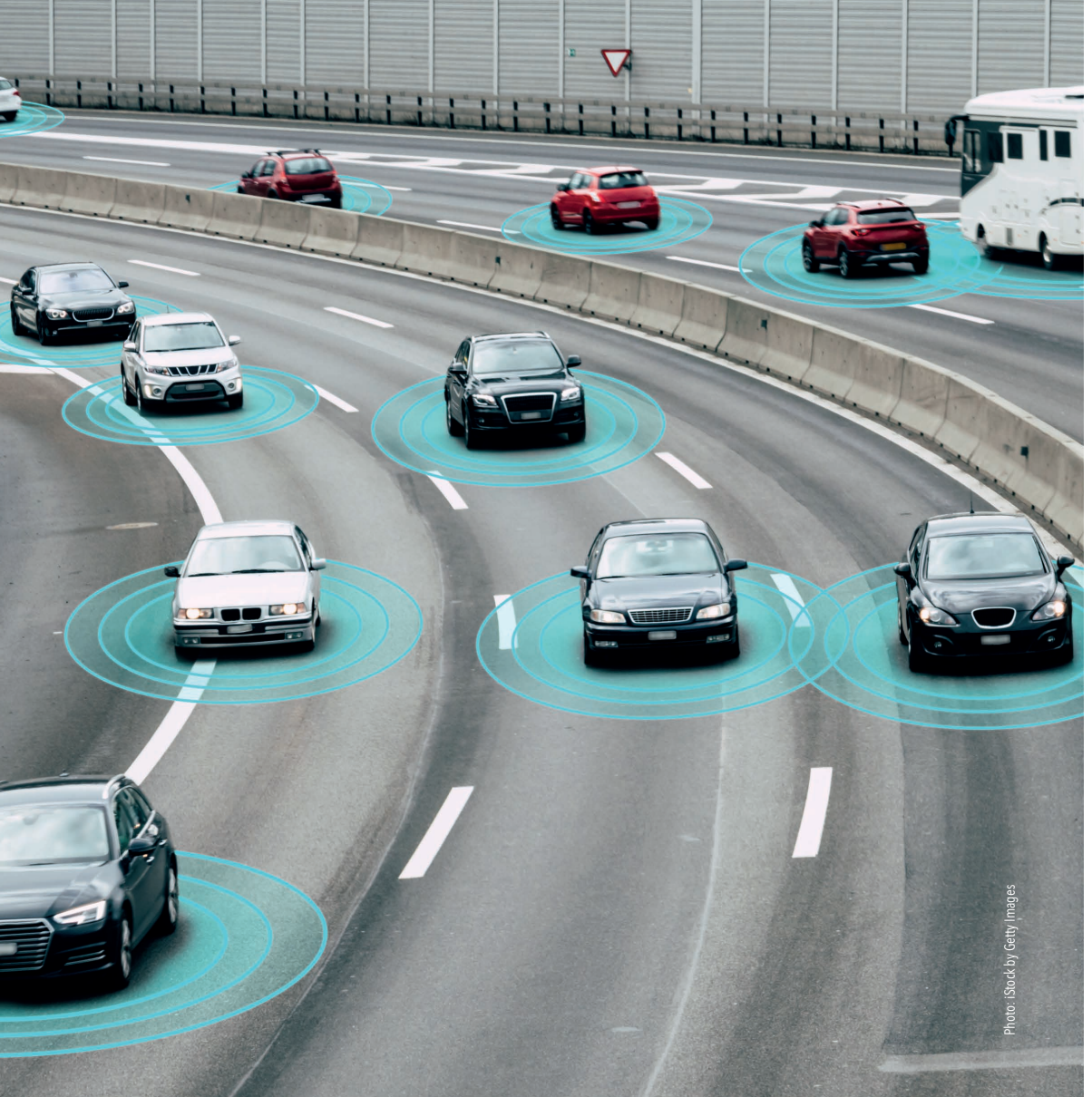


Photo: iStock by Getty Images

SMART VEHICLES ALSO RAISE QUESTIONS

As part of move, Empa is also investigating questions regarding self-driving vehicles:

- Which sensor technology is necessary for safe operation?
- Which sensors can fail before the car becomes hazardous?
- Which data must be stored and made available for legal proceedings?
- What requirements must the sensors meet for official approval?

GENERATING KNOW-HOW TOGETHER

AN OPEN PLATFORM

move is a cooperation between research, industry and the public sector. The demonstration platform allows partners to assess novel technologies; moreover, they can have specific problems be supported scientifically.

CORE PARTNES

All partners: empa.ch/web/move/partners

THINKING OUTSIDE THE BOX

THE INNOVATION DISTRICT ON THE EMPA CAMPUS

Several research and technology transfer platforms have been established on the Empa campus in Dübendorf in recent years. Together they form an interconnected district, in which innovative and comprehensive solutions in the energy, building and mobility sectors can be developed and demonstrated in a real-world environment.

NEST
Exploring the future of buildings
nest.empa.ch

move – Future Mobility
Mobility without fossil fuels
move.empa.ch

ehub – Energy Hub
Energy research on district level
ehub.empa.ch

dhub – Digital Hub
Digital solutions for buildings, mobility and energy
dhub.empa.ch

Water Hub
Wastewater as a resource
eawag.ch/waterhub

concept&design
PAUL AND CAT
2020

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