Energy
National Research Programmes 70 and 71

Project

Methane for transport and mobility (RMTM)

Methane-powered vehicles

Methane-powered vehicles

If you decide you want to reduce your CO_2 emissions, you should not drive a car. But this is not an option for everyone. An attractive alternative is the use of methane as a fuel. Combustion of this gas causes less CO_2 emissions than petrol. Moreover, the production of this fuel could also solve the storage problem related to solar and wind energy, since methane can be stored for long periods of time.



Whether future cars will be fuelled with renewable methane as opposed to fossil fuels is a political rather than a technical issue. *Source:* iStock

At a glance

- Not only is synthetic natural gas renewable and climate-neutral. It also functions as a storage medium for renewable energies.
- The production of methane is technically possible and the well-developed Swiss gas network would provide a system for its distribution.
- However, the future use of this gas in Switzerland depends primarily on political decisions.

Half of all CO_2 emissions produced by human activity in Switzerland are caused by road traffic. These emissions must be reduced, as Switzerland has committed itself to this objective within the scope of its Energy Strategy 2050. Leaving one's car in the garage and switching to public transport is by far the best solution, but this is not an option for everyone. Alternatives are needed, and one of them is to switch to renewable fuels that can be produced climate-neutrally. One of these is synthetic natural gas, which is nothing more than artificially produced methane. In terms of the implementation of the energy strategy it is of particular interest, as a car running on synthetic natural gas kills two birds with one stone. Firstly, fluctuations in energy production will be unavoidable if, according to plan, Switzerland increasingly relies on renewable energies such as solar and wind energy: sun and wind are not always available when needed. Conversely, energy is also produced when there is no demand. Precisely this electricity can be used to produce synthetic gas, which thus functions as a long-term energy storage. Batteries, on the other hand, are useful for short-term storage.

Secondly, this renewable fuel is produced from CO_2, turning this greenhouse gas into a resource. Boris Meier, the project leader, and the team surrounding Markus Friedl, professor at the Institute for Energy Technology at the Hochschule für Technik in Rapperswil (HSR), have investigated whether and under what conditions synthetic natural gas has the potential to become a fuel substitute for Swiss road traffic. Their conclusion is that the future use of methane as a fuel in road traffic is much more a political than a technical question.

Water and carbon dioxide: inexhaustible resources

The production of this renewable fuel calls for water, carbon dioxide from the air and electricity (see box). Switzerland's supply of the raw materials water and CO_2 is practically unlimited. According to calculations, even if all Swiss road traffic were to run on synthetic gas for one year, the production would require only two percent of the drinking water consumed annually by the Swiss population. Air serves as the source of CO_2. Since 15 % of the CO_2 emissions in Switzerland are concentrated in 35 locations, such as cement or waste incineration plants, the researchers suggest extracting this raw material directly at these points. This filtering process is much more efficient than extracting CO_2 from the air.

The main question is the availability of the electricity needed to produce the gas. If all road traffic were to be powered by methane, the greenhouse gas emissions released in Switzerland could be reduced by up to 52 %. However, this calculation is only valid if the required electricity is produced from renewable energy sources and not in power stations that run on fossil fuels (oil, gas, coal) and release CO_2. According to the researchers, it is consequently important that Switzerland does not import electricity from abroad for the production of methane as a fuel.

Synthetic natural gas

Synthetic natural gas, which can be used as a fuel in car engines, is in fact methane (CH_4). It is produced using renewable electricity, carbon dioxide (CO_2) and water. The electricity is required to split the water into oxygen and hydrogen in a process known as electrolysis and also to filter CO_2 from the air, from a biogas plant, or from the flue gases discharged by a waste incineration plant. The hydrogen then reacts with the CO_2 to form methane, which can later be used to drive a car equipped for this purpose. A gas-powered car emits approximately 20 % less greenhouse gases than a petrol-fuelled car and the remaining 80 % were previously reduced in the atmosphere. Therefore, synthetic methane-powered mobility is virtually CO_2-neutral.

Costly technology

The efficiency of synthetic gas production depends primarily on the efficiency of water electrolysis. Although the process is technologically well established, the cost for the purchase of the required equipment is still high and there is room for improvement regarding its performance.

With the exception of a test facility at the HSR, there are still no plants for the production of synthetic gas in Switzerland, and tanks for methane gas storage would have to be built. However, storage capacity near the border in France and Germany would make it possible to start implementing the project. And, according to the researchers, the gas pipeline network is sufficiently developed to allow for the distribution of the synthesised methane.

Acceptance, market and political decisions

Hence, neither resources nor technology are insuperable obstacles for Switzerland. Acceptance, the market and political processes are more difficult to evaluate. Therefore, in order to assess the feasibility of the project, the researchers have also reflected on these factors and have come to the following conclusions:

- **Acceptance**: based on interviews with people who have visited the synthesis gas plant at the HSR in Rapperswil, it is known that many citizens have concerns regarding the safety of gas stations and methane-powered vehicles. The researchers believe this is unjustified, as the gas network and natural gas heating are already well established and accepted in Switzerland. It is therefore important to educate the population concerning the use of gas-powered vehicles.
- **Market**: the uncertainty of the future market situation makes it difficult to assess the potential of synthetic gas. Whether the production of synthetic methane can establish itself depends on factors such as the price for electricity, the cost of gas on international markets and exchange rates.
- **Political decisions**: under today's legislature, the electricity required for the production of synthetic methane would be subject to a grid fee as well as further charges on the sale of methane. Similarly to the taxes already due by Swiss citizens who opt for an electricity package consisting largely of renewable energies, these fees would have to be paid by the consumers, which means that renewable gas could not compete with fossil fuels. However, if the grid fee were to be waived, for instance, gas production could become profitable within ten to twenty years.

Another option to increase the competitiveness of synthetic gas would be to introduce incentive charges on diesel or petrol. For example: if a kilowatt-hour of electricity for the production of renewable gas costs 13 centimes (including grid charges), 2.7 Swiss francs per litre would have to be levied on diesel or petrol to compensate for the price difference. Such a tax could be increased in stages over several years. This would make fossil fuels progressively unattractive and the switch to renewable methane more profitable.

In conclusion, the researchers believe that the use of synthetic methane as a fuel for Swiss road traffic has great potential, providing the adequate policy framework is available. Once gas can compete with conventional fuels, not only will this technology eliminate the storage problem of electricity from wind and solar power plants. The conversion of CO_2 to methane will also actively contribute to the reduction of Switzerland's greenhouse gas emissions.

Produkte aus diesem Projekt

- Kick-off-Poster
  Date of publication: 16.01.19
- CO2 als Rohstoff für Treibstoffe
  Date of publication: 16.01.19
- Interview Methanisierung
  Date of publication: 16.01.19
- Carbon Flows in the Energy Transition
  Date of publication: 28.05.19

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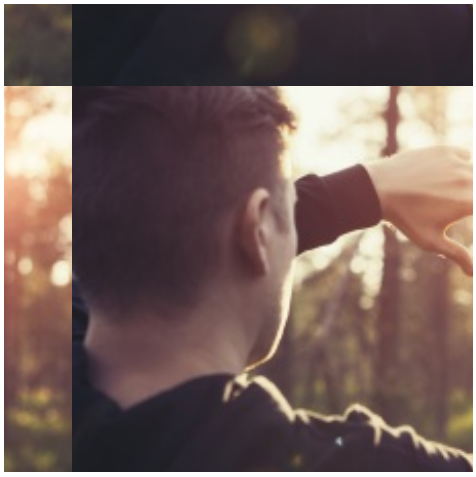
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Associated projects



PEM fuel cells

Fuel Cells for Sustainable Mobility



Sustainability of methanation

Which is the optimal power-based fuel?

All information provided on these pages corresponds to the status of knowledge as of 02.05.2019.