Media communiqué

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The «Clean Engine Vehicle» developed by Empa und ETHZ wins the German gas industry's Innovation Prize

A clean win with natural gas and biogas

A milestone for the «Clean Engine Vehicle» (CEV) developed by Empa and the ETH Zurich! The gas-fuelled automobile received the Innovation Prize for environmentally friendly mobility awarded by the German gas industry. The award, which was presented on October 17th in Berlin, is accompanied by prize money of €12,000 and honors innovative new ideas involving natural gas as a source of energy.

In the opinion of the jury the cooperative project by Empa's Internal Combustion Engines Laboratory and two groups from the ETH Zurich, the Aerothermochemistry and Combustion Systems Laboratory (ACL) and Measurement and Control Laboratory, demonstrates in an impressive manner that cars with the latest natural gas fuelled engines can emit 30% less carbon dioxide (CO_2) than state-of-the-art petrol fuelled cars of the same power rating. "The award shows that research work in Switzerland is taken seriously abroad," says a pleased Christian Bach of the Empa, leader of the project.

Higher efficiency and lowest emission levels

The CEV also emits such a low level of pollutants in its exhaust gas that it meets even the most stringent regulation currently applied, those in California. According to Bach, the concentration of nitrogen oxides (NOx) in the exhaust gas during stop-and-go urban driving cycles actually lies below that of the air aspirated into the motor, and this only 700 meters after a cold start. In a petrol motor such a performance would be simply impossible without expensive and time-consuming measures. In addition, because of its low hydrocarbon emissions (which are in any case less noxious and more weakly reactive in atmospheric chemistry terms than NOx) the CEV technology hardly contributes to the ozone situation. The formation in the air of this irritant gas is a problem, particular in summer, for vehicles with petrol and diesel motors. In terms of particle emissions the new engines fare even better. Fine particulate emission, that is the number of particles emitted per cubic meter of exhaust gas, is actually about 100 times less than that of conventional petrol engined vehicles. The CEV concept therefore reduces in one fell swoop the three most important environmental problems of individual mobility. An additional advantage is that cars with CEV drives need no modification to be able to use preprocessed biogas, such as compost-derived compogas. The starting point for the project hardware was a standard VW Polo with a one liter displacement, 37 kilowatt motor. As a first step the Empa and ETH engineers converted the engine to use natural gas as a fuel by increasing the compression ratio and designing and integrating a regulated turbocharger unit, thereby raising the power output to 44 kilowatts. The next target was to reduce fuel consumption and

exhaust emissions. Conventional exhaust treatment techniques used for petrol engines are not suitable for use with natural gas burning motors, so the project scientists developed a catalyzing system optimized for gas fuel and adjusted the motor regulation system appropriately. Together with VW, Bach and his fellow researchers then developed optimized catalytic systems for the next generation of natural gas engines. Because of its high knock tolerance (up to 130 octane compared to 95 or 98 octane for petrol motors) natural gas is extremely well suited to use as a fuel, allowing the efficiency to be increased significantly in comparison to petrol engines. With the CEV motor this increase in efficiency is about 10%, despite the stringent requirements imposed by the aim of achieving the lowest possible exhaust emissions. The gas motor CO_2 emissions – already low – were thereby reduced even further. However the composition of natural gas (which varies much more strongly than petrol) and the stability of the methane molecule, the major component of the hydrocarbon emissions, proved to be particular challenges to the development team. To counter these factors the ability of the motor control system to adapt automatically to the current gas composition had to be improved, and adjustments made to the catalytic converter control loop (for example in terms of cold start and warm-running strategies).

Computer simulations – an important tool

The role played by computer modeling during the project was vital to its success. The computer simulation of the combustion process, which was developed in the course of a doctoral dissertation, enabled the Empa and ETH engineers to study the combustion in detail, allowing them to further optimize the motor and gear system as well as aiding in the design of a suitable turbocharger. The end result was a reduction of fuel consumption of about 10 per cent. The «Clean Engine Vehicle», the development of which was supported by the Swiss Federal Office of Energy (SFOE) as well as the Swiss, German and Austrian gas industry, has enabled Empa and ETH researchers to demonstrate that an appropriately equipped natural gas fuelled vehicle emits significantly less noxious exhaust emissions than current petrol or diesel engined vehicles. In other words, with the help of natural gas technology it is possible today to build economic, practically emission-free vehicle power trains with low CO_2 production. Christian Bach is convinced that "…in the future the fuel market will undergo strong diversification. What I mean is that many other fuels will begin to be used in addition to petrol and diesel. Natural gas and biogas will find their place in this market too."

Author: Lukas Herzog

The German gas industry's Innovation Prize for environmentally friendly mobility

Every two years the Association for the Efficient and Environmentally Friendly Use of Energy (ASUE) and the Allgemeine Deutsche Automobilclub (ADAC) award their Innovation Prize for forward looking projects in the field of environmentally friendly mobility. The patrons are the Federal Association of German Gas and Water Industries (BGW) and the German Technical and Scientific Association for Gas and Water (DVGW) This year the prize was presented for the 14th time at a commemorative event in the Kaisersaal in Berlin by Astrid Klug, Secretary of State of the German Federal Ministry of the Environment (BMU).

Further information:

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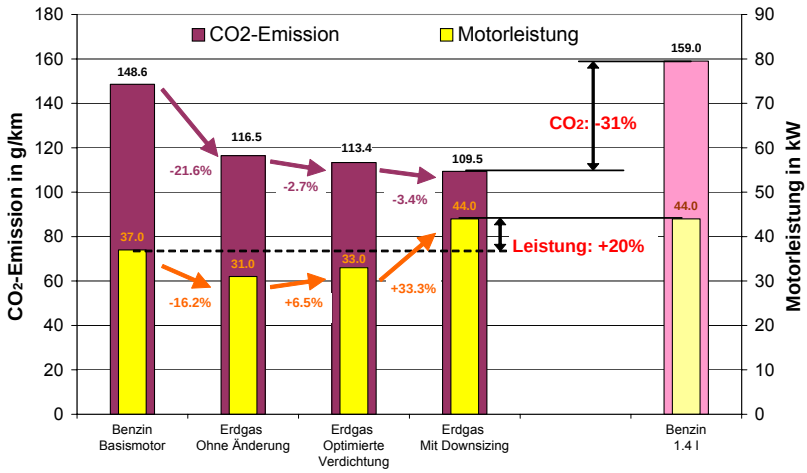
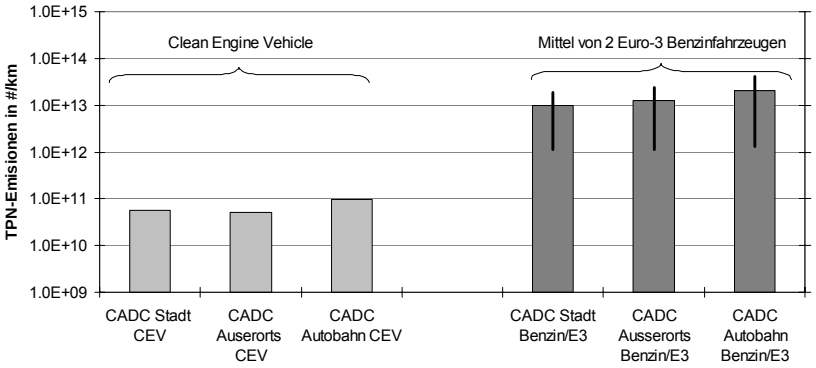
The «Clean Engine Vehicle» (CEV) project test vehicle, a VW Polo



Reduction of CO_2 emissions compared to a petrol engine of the same performance



Particle emissions compared to a conventional petrol engine vehicle during a “real world“ driving cycle.

Left to right: Reinhard Schueler (ASUE), Konstantinos Boulouchos (ETH), Christian Laemmle (Empa/ETH), Christian Bach (Empa), David Dyntar (ETH), Astrid Klug (BMU), Michael Feist (BGW), Werner von Scheven (ADAC) and Wolfgang Richter (TU Dresden and head of the jury)