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Regenerative Methane rather than Heavy Fuel Oil and Marine Diesel

Clean shipping with ZSW's power-to-gas process

Time and again, scientists have pointed to the hazards of pollutant emissions from shipping. Particulate matter, sulfur oxide and nitrogen oxide harm the environment and endanger coast-dwellers' health. This problem can be defused by methane, preferably produced using the power-to-gas (P2G[®]) process developed by the Center for Solar Energy and Hydrogen Research Baden-Wuerttemberg (ZSW). This synthetic gas releases virtually no particulate matter when it combusts, making it a climate-friendly fuel for ships and other vehicles.

Cruise ships, freighters and ferries emit tons of pollutants when they set out to sea. Environmentalists and health experts have repeatedly warned that sulfur and nitrogen oxides, particulate matter and carbon dioxide pollute the air, endanger the environment, and threaten the health of people, even of those far beyond major port cities. When ships run their diesel generators to produce the electricity used on board, they emit a massive amount of exhaust gases even when berthed in ports. Out at sea, ships' engines run on heavy fuel oil, which is cheaper but far more polluting than marine diesel. European Union regulations now prohibit its use in coastal waters. The black fumes are rife with toxins, and the soot particles are held to be particularly hazardous to people's health. A recent study conducted by Munich's Helmholtz Center, the University of Rostock and other institutions found that these particles can cause serious lung diseases.

"Air pollution from shipping and the impact on humans and the climate have long been underestimated," says ZSW researcher Dr. Michael Specht. The head of ZSW's department "Renewable Fuels and Processes" added that particulate filters could serve as a short-term stopgap to keep the problem in check, but it would be more effective to replace harmful heavy fuel oil and marine diesel with clean-burning, carbon-neutral methane produced by the P2G[®] process.

The concept behind P2G[®] is to convert excess renewable electricity into hydrogen by way of electrolysis. This sustainable hydrogen, in turn, can then be combined with carbon dioxide — preferably the biogenic kind — and converted into methane that is stored within the natural gas grid or used directly in households, industry and as a carbon-neutral fuel for natural gas-powered vehicles. The feasibility of this alternative for climate-friendly mobility has already been demonstrated successfully in several research projects, and ZSW has teamed up with commercial enterprises to bring the underlying technology to market.

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An industrial six-megawatt plant is up and running at the Lower Saxony town of Werlte, and ZSW researchers contributed to its construction and operation with their many years' experience researching, developing and demonstrating P2G[®] in action.

"Methane can be converted into LNG, or liquefied natural gas. The technology for it to drive marine engines and on-board power generators is available and is already being used for inland waterway transportation. Virtually no particulate matter is emitted here," says Specht.

Fossil LNG, however, does not provide the solution that ZSW scientists have in mind. For one, this methane can escape into the atmosphere during transport; for the other, Europe would then be as heavily dependent on gas imports as it is now on foreign oil. The power-to-gas method, however, allows the production of renewable fuel in Germany and other European countries.

"With LNG based on renewable electricity, ships will be able to use it to run in a carbon-neutral and sulfur-free way," said Specht. Other pollutants would also be greatly reduced. A comparison made by the IAV Group from October of 2015 shows that a car powered by natural gas not only produces 99 percent less particulate matter; it also emits 90 percent less nitrogen oxide than a diesel-driven model (Euro 6). Specht said that these figures can be transferred analogously to shipping.

Today electrical power can be converted into LNG with around 50 percent efficiency. "We can live with that if we expand production capacity for regenerative electricity and keep heading down this path to a post-fossil fuel era," said Specht. The Commission of the European Union evidently shares Specht's viewpoint: In its new European strategy for low-emission mobility announced on July 20, 2016, it expressly advocates the use of LNG and power-to-gas in shipping and trucking.

The Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (Centre for Solar Energy and Hydrogen Research Baden-Württemberg, ZSW) is one of the leading institutes for applied research in the areas of photovoltaics, renewable fuels, battery technology, fuel cells and energy system analysis. There are currently around 230 scientists, engineers and technicians employed at ZSW's three locations in Stuttgart, Ulm and Widderstall. In addition, there are 90 research and student assistants.

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