

Hybrid energy transfer lines with liquid hydrogen and superconducting cable - first experimental proof of future power lines.

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The transfer of high power flow over long distances will be the one of the major task for energetics in this century. Liquid hydrogen attraction is clear -- it has the highest energy content of any known fuel and when it's burned, the "waste" is water. It could be transferred via cryogenic tubes like other cryogen liquid. Moreover, with the use of "gratis" cold to cool a superconducting cable an extra electrical power can be delivered with the same line. One of solutions is to use DC power cables made of cheap MgB₂ superconductor with single phase liquid hydrogen as a cooler and energy carrier. The team of Russian researchers developed and tested the two first in the world prototypes of the future hydrogen and superconducting energy transport systems. Two systems with 10 m length (in 2011) and 30 m length (in 2013) has been developed and tested. The first system with 2.5 kA cable and outer diameter ~80 mm could deliver ~30 MW of chemical energy by liquid hydrogen and ~ 50 MW of electrical power at 20kV and 2.5 kA, i.e. ~80 MW in total. The second system with diameter ~120 mm underwent high voltage test at 50kV DC and could deliver ~55 MW of chemical energy by liquid hydrogen and ~ 75 MW of electrical power at 25kV and 3 kA or ~130 MW of power in total. Details of hybrid energy transport lines and their test results are presented.