The Status, Momentum and Potential of Low Energy Nuclear Reactions

The world needs new sources of clean energy due to the growing population, developing countries, and the several known dire consequences of climate change caused by burning fossil fuels. Besides renewable energies, the world urgently needs new sources of powerful energy that can be controlled at will and characterized by (a) large energy releases per reaction compared to chemical fuels, and associated high energy and power densities, and (b) production of energy without greenhouse gases. Three types of such energy generators are available or under development.

Nuclear fission of heavy elements is a reliable source of clean energy. However, it has significant drawbacks, including huge facilities, large amounts of long-lived radioactive waste, and major problems from rare accidents. There is great interest now in smaller fission systems.

Fusion of light isotopes of hydrogen has attracted tens of billions of dollars of research funding over the past 75 years. It requires temperatures of about 100 million degrees in low-density plasmas, and strong magnetic fields to contain the plasmas. It is expected that hot fusion systems will supply power to the electrical grid in a few countries during the 2030s. Hot fusion reactors are large machines with multi-megawatt powers that still produce significant radioactive waste.

Cold fusion burst on the scene in 1989. It is now called Low Energy Nuclear Reactions (LENR) or Solid-State Fusion (SSF). Over 35 years of research in more than a dozen countries have shown that it is indeed possible to trigger very energetic reactions at modest temperatures in special catalysts loaded with hydrogen. High energy gains have been demonstrated in LENR experiments, so LENR energy might be relatively cheap, when it is commercialized. Because solids catalyze LENR, experiments have shown that energy generators based on LENR should offer high power densities, and hence compact systems. Widely distributed LENR generators with kilowatt outputs appear to be possible for powering homes and businesses. And, it is known from many experiments that LENR do not emit significant dangerous radiation, and produce hardly any radioactive waste.

The scientific study of LENR remains challenging due to highly variable experiments, probably caused by vagaries of the required materials. The fundamental physics of how LENR occur pertains to Quantum Mechanics effects and is still not yet completely understood. Despite these problems, the commercialization of LENR is proceeding. Eleven startup companies are striving to produce commercial LENR generators in Asia, Europe, and America.

The momentum of LENR is due to interest by governments, as well as by investors. A long-term program in Japan, a program in Europe since 2020, and a program in the U.S. from 2023 have legitimized and advanced the study of LENR. Those programs are each about $10M. If LENR captured 1/1000 of the annual market for energy globally, which is $10T, the companies could be worth billions of dollars.

The two major challenges to LENR now are (a) scaling to output energies to the range of kilowatts with significant gains, and (b) the long-term durability of the active materials in LENR generators. LENR is at a stage where collaborations can accelerate understanding and commercialization.

The 17th International Workshop on Hydrogen Loaded Materials will gather the best specialists of the World on both the scientific study and commercialization of LENR. This workshop is not merely a venue for presentations; it is a place to test ideas, validate claims, and define the questions that matter. We welcome those who wish to engage, compare, replicate, and build knowledge of LENR together.

David J. Nagel
Research Professor – George Washington University
Washington DC - USA
27/11/2025

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https://iscmns.org/event/iwahlm-17/

https://www.sfsnmc.org/index.php/iwahlm-17/