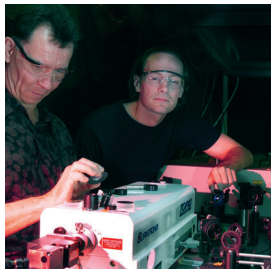
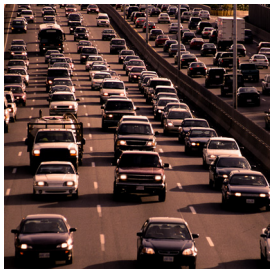
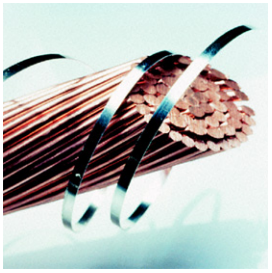
Los Alamos NATIONAL LABORATORY EST. 1943

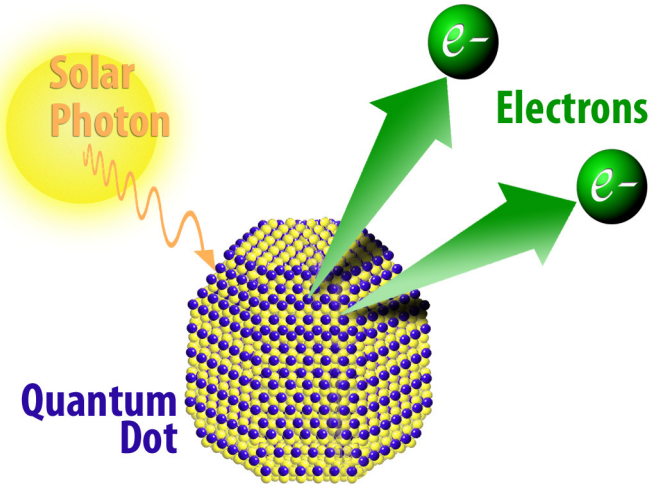
We are applying our expertise in chemical and materials science to provide innovations in renewable energy generation, storage, and use.

Renewable Energy Innovations

Meeting future energy needs in an environmentally responsible way requires scientific breakthroughs to efficiently generate, store, transmit, and use large amounts of power. We need cost-effective methods for capturing and converting energy from the sun, and because of the intermittent nature of solar and other renewable energy sources, we must be able to store this energy for use when demand is high. We also need to move much greater amounts of energy more efficiently and reliably from where it is produced to where it is consumed. The unique blend of scientific disciplines, capabilities, and facilities that stem from Los Alamos National Laboratory's national security missions are being used to develop new materials to overcome key technical barriers to the widespread deployment of renewable and alternative energy. Los Alamos integrates high-performance computing and simulation with advanced experimentation to understand, design, and control materials and their properties.

Solar Energy: Nanomaterials for Photovoltaics

The inexhaustible supply of photons streaming from the sun seems like the ideal clean energy source, yet solar power accounts for less than 0.1% of current U.S. electricity. For photovoltaics to be a major contributor to the grid, significant scientific advances are required to meet cost targets.

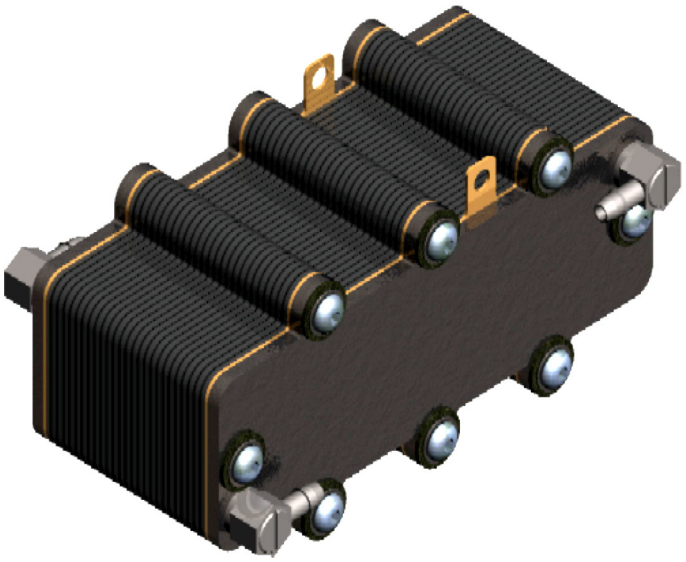


Unlike conventional solar panels, solar cells based on nano-sized "quantum dots" can generate multiple electrons per photon, greatly increasing efficiency.

Innovative materials and concepts are needed to efficiently separate and harvest electric charges from solar radiation. Los Alamos researchers have demonstrated that nanoscale crystals, called "quantum dots," can generate multiple charge carriers from the absorption of a single photon of light. This phenomenon, called "carrier multiplication," arises from the unique physics of nanomaterials and could provide conceptually new approaches that may dramatically improve solar energy conversion efficiency. While significant technical hurdles still remain before carrier multiplication can be used in devices, this advance could open the door to next-generation solar panels that are far more cost-effective.

Fuel Cells and Hydrogen Storage

Every year since the mid-1980s, the U.S. has used more petroleum for transportation than the total of its domestic production. Fuel cells, which convert chemical fuels directly to electricity, could radically change the way we use energy in both stationary and transportation applications. Los Alamos has been the DOE's leading laboratory for low-temperature fuel cell research for 30 years and is responsible for key breakthroughs in polymer electrolyte membrane (PEM) fuel cells that are being explored and used throughout the world. Los Alamos' work on materials development and durability testing has helped enable the emerging fuel cell industry. DOE Secretary Bodman described the Laboratory's fuel cell partnership with General Motors as "a shining example of how a national laboratory can work with industry to the benefit of both." Our current research focuses on obtaining the fundamental understanding required to improve materials and processes to overcome the cost and durability barriers that prevent fuel cells from becoming a viable alternative to petroleum-based internal combustion engines.



Fuel cell stack for portable power developed at Los Alamos National Laboratory.

If we are to replace gasoline-powered vehicles with clean hydrogen-powered fuel cell vehicles, we must find a way to store enough hydrogen on board to provide an acceptable driving range. Los Alamos leads the DOE Chemical Hydrogen Storage Center of Excellence, a partnership of 13 research and industrial institutions working to store hydrogen in chemical bonds that can then be reacted to release hydrogen on-board. The Center has made significant advances in a hydrogen carrier based on the compound ammonia-borane. We have developed a number of methods to release hydrogen from ammonia-borane on demand as well as chemical routes that could potentially meet DOE energy efficiency targets for regenerating the spent storage material. In addition to providing much higher storage capacity than hydrogen gas, chemical hydrogen carriers could overcome the infrastructure obstacle for hydrogen by enabling use of our current fuel delivery infrastructure of pipelines and tanker trucks, which would save billions of dollars.

High-Temperature Superconductivity

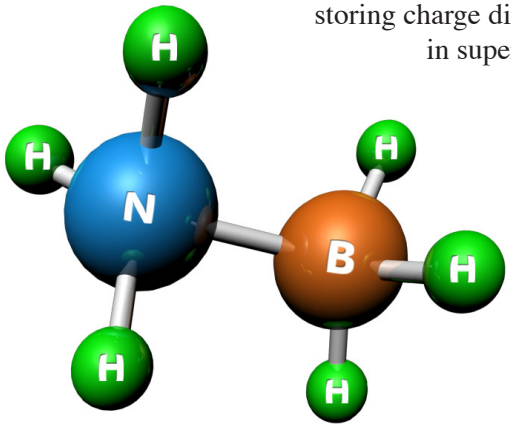
Los Alamos' expertise in materials science is also helping to improve the efficiency and reliability of the nation's electricity transmission infrastructure. Superconductivity offers the promise of reducing transmission losses, allowing for more power to be dispatched along congested corridors and providing direct current links between independent utility grid sections to control grid stability.

Los Alamos discoveries were critical in the development and manufacturability of high-temperature superconducting tape and cable. Initial field trials are underway by our industrial partners, but wide-scale adoption and installation are still some years away.

Energy Storage: An Emerging Los Alamos Initiative

A 2007 DOE Office of Science report concluded that "revolutionary breakthroughs in electrical energy storage have been singled out as perhaps the most crucial need for this nation's secure energy future." Evolution of existing storage technologies will not be sufficient to meet our needs for portable power, transportation, and electric grid energy storage. Advances are particularly required for large-scale electrical energy storage to enable full utilization of intermittent renewable energy sources such as solar and wind power on the electrical grid.

Los Alamos is working on materials and chemical processes for energy storage with a focus on understanding, designing, and manipulating materials and chemical processes at the nano- and micron scale. The Laboratory is pursuing two general approaches: 1) storing charge directly on surfaces in supercapacitors with a hundredfold increase in capacity to rival batteries; and 2) storing and harvesting electrons from chemical bonds to develop efficient, reversible storage systems with capacities much higher than possible with other forms of energy storage. Both areas require similar nanotechnology, materials and concepts for electrodes, electrocatalysts, electrolytes, and dielectrics. Los Alamos and its collaborators have all the science components needed for innovation in these areas including predictive theory and modeling of materials as well as design, fabrication, and testing of nanostructured architectures.



Ammonia-Borane could be the key to storing enough hydrogen on board to power fuel cell vehicles.

Los Alamos National Laboratory is operated by Los Alamos National Security, LLC, a team composed of Bechtel National, the University of California, The Babcock & Wilcox Company, and Washington Division of URS for the Department of Energy's National Nuclear Security Administration.

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