by

AMERICA'S NATIONAL LABS

America's National Laboratory

system has been changing and improving the lives of millions for more than 80 years. Born at a time of great societal need, this network of Department of Energy Laboratories has now grown into 17 facilities, working together as engines of prosperity and invention. As this list of 50 Breakthroughs attests, National Laboratory discoveries have spawned industries, saved lives, generated new products, fired the imagination, and helped to reveal the secrets of the universe. Rooted in the need to be the best and bring the best, America's National Laboratories have put an American stamp on the past century of science. With equal ingenuity and tenacity, they are now engaged in winning the future.

At America's National Laboratories, we've:

Explained photosynthesis.

Ever wonder how plants turn sunlight into energy? A National Lab scientist determined the path of carbon through photosynthesis, a scientific milestone that illuminated one of life's most important processes. Today, this work allows scientists to explore how to derive sustainable energy sources from the sun.

Exposed explosives.

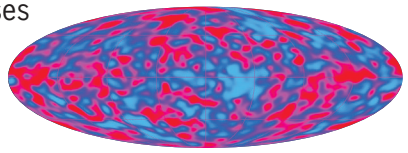
A credit-card-size detector developed by National Lab scientists can screen for more than 30 kinds of explosives in just minutes. The detector, called ELITE, requires no power and is widely used by the military, law enforcement and security personnel.

Put the jolt in Chevy's Volt.

The Chevrolet Volt would not be able to cruise on battery power were it not for the advanced cathode technology that emerged from a National Lab. The same technology is also sparking a revival of America's battery manufacturing industry.

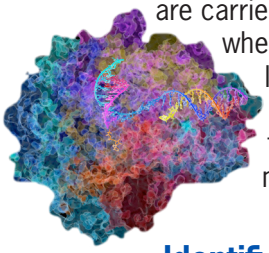
Confirmed the Big Bang, and discovered dark energy.

National Lab detectors aboard a NASA satellite revealed the birth of the galaxies in the echoes of the Big Bang. Dark energy—the mysterious something that makes up three-quarters of the universe and causes it to expand at an accelerating rate—was also discovered by National Lab cosmologists.



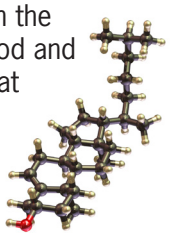
Found life's mystery messenger.

National Lab scientists discovered how genetic instructions are carried to the cell's protein-manufacturing center, where all of life's processes begin. Subsequent light-source research on the genetic courier, called messenger RNA, has revealed how the information is transcribed and how mistakes can cause cancer and birth defects.



Identified good and bad cholesterol.

The battle against heart disease received a boost in the 1960s when National Lab research unveiled the good and bad sides of cholesterol. Today, diagnostic tests that detect both types of cholesterol save lives.



Created the toughest ceramic.

National Lab scientists mimicked the structure of mollusk shells to create what might well be the toughest ceramic ever produced. The material could lead to incredibly strong yet light composites that are perfect for energy and transportation applications.

Helped catch criminals.
To DNA testing, we can now add human antibody detection, a precise method of matching suspects to crime scenes. The technique, created by National Lab scientists, also foils would-be drug test cheaters.

Made refrigerators cool.

Next-generation refrigerators will likely put the freeze on harmful chemical coolants in favor of an environmentally friendly alloy, thanks to National Lab scientists.

Brought safe water to millions.
Removing arsenic from drinking water is a global priority. A long-lasting particle engineered at a National Lab can now do exactly that, making contaminated water safe to drink. Another technology developed at a National Lab uses ultraviolet light to kill microbes that cause water-borne diseases such as dysentery. This process has reduced child mortality in the developing world.

Delivered troops safely.

National Laboratory researchers have developed computer models that effectively manage the complex logistical tasks of deploying troops and equipment to distant destinations.

Brought the Web to the U.S.
National Lab scientists, seeking to share particle physics information, were the first to install a web server in North America, kick-starting the development of the Web as we know it.

Mapped the universe—and the dark side of the moon.
Credit for producing a 3D map of the sky, and 230 million celestial objects, goes to National Lab scientists, who also developed a camera that mapped the entire surface of the moon.

Found fuel in sewer slime.
National Lab scientists discovered how to use a catalyst to turn gooey residue in food-service grease traps into clean, high-quality biodiesel.

Unmasked a dinosaur killer.

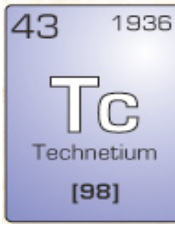
Natural history's greatest whodunit was solved in 1980 when a team of National Lab scientists pinned the dinosaurs' abrupt extinction on an asteroid collision with Earth. Case closed.

Fought pump friction.
Friction generated by industrial hydraulic pumps costs industry millions of dollars per year in energy bills. A National Lab developed a ceramic coating from an alloy of boron-aluminum-magnesium that reduces pump friction, decreases wear and tear, and may one day pump money back into business.

Pitted cool roofs against carbon dioxide.

National Lab researchers and policy experts have led the way in analyzing and implementing cool roofing materials that reflect sunlight, lower surface temperature, and slash cooling costs. Think globally: If all the world's roofs and pavement used cool materials, the reduction in carbon dioxide emissions would be equivalent to taking the world's 600 million cars off the road for 18 years.

Toughened airplanes.
A National Lab and industry technique for strengthening metal by bombarding it with laser pulses has saved the aircraft industry hundreds of millions of dollars in engine and aircraft maintenance expenses.

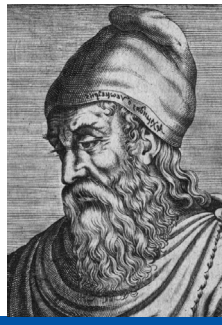
Discovered 16 elements.


The periodic table would be smaller without the National Labs. Among the Labs' handiwork is an instrumental role in the discovery of technetium-99, which has revolutionized the field of medical imaging. Another discovery, americium, is widely used in smoke detectors.

Gotten the lead out.
Removing hazardous lead-based solders from the environment is now a reality thanks to a lead-free alloy of tin-silver-copper developed at a National Lab. The lead-free solder has been licensed by more than 60 companies worldwide.

Pioneered efficient power lines.
New kinds of power lines made from superconductors can carry electric current with no energy loss. Now deployed by National Lab scientists, these prototypes could usher in a new era of ultra-efficient power transmission.

Seen inside weapons.
National Lab technology that quickly identifies the chemical makeup of weapons has been used to verify treaties around the world.

Restored ancient knowledge.

The works of famed ancient mathematician Archimedes—written over by medieval monks and lost for millennia—were revealed to modern eyes thanks to the X-ray vision and light-source technology found at a National Lab.

Put the digital in DVDs.

The optical digital recording technology behind music, video, and data storage originated at a National Lab nearly 40 years ago.

Reduced air conditioning costs.

Air conditioning is a huge energy drain. National Lab scientists invented an air conditioning process that uses up to 90% less energy that today's top-of-the-line units. Cooling down cheaply might one day be a breeze.

Levitated trains with magnets.

Say goodbye to traffic jams. National Lab scientists developed a technology that uses the attractive and repulsive forces of magnets to levitate and propel trains. Maglev trains now ferry commuters in Japan and China and will be operational in other countries soon.

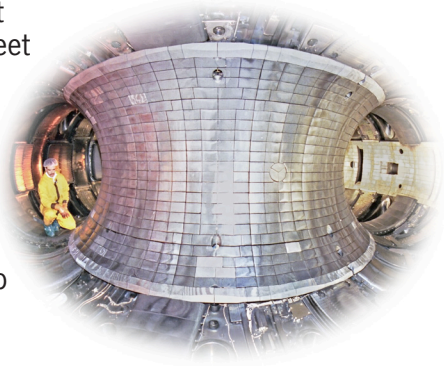
Exposed the radon risk.

You can sleep easier thanks to National Lab research that quantified the health risk posed by radon gas in parts of the country. Subsequent EPA standards, coupled with radon detection and mitigation measures pioneered by National Lab scientists, prevent the naturally occurring gas from seeping into basements, saving thousands of lives every year.

Squeezed fuel from microbes.

In a milestone that brings advanced biofuels one step closer to America's gas tanks, a collaboration led by scientists with the Department of Energy's Joint BioEnergy Institute developed a microbe that can produce fuel directly from biomass. The research team, which includes National Lab scientists, engineered a strain of *Escherichia coli* bacteria to secrete biodiesel fuel.

Shown that fusion is not fantasy.



From a fusion test reactor that produced enough power to meet the energy needs of 3,000 homes to the fusion-ignition potential of the world's largest and most energetic laser, fusion science is moving closer to commercial reality because of National Lab scientists.

Tamed hydrogen with nanoparticles.

To replace gasoline, hydrogen must be safely stored and easy to use, but this has proved elusive. National Lab researchers have now designed a new pliable material using nanoparticles that can rapidly absorb and release hydrogen without ill effects, a major step in making fuel-cell powered cars a commercial reality.

Made wind power mainstream.

Increasing wind-turbine efficiency with high-efficiency airfoils has reduced the cost of wind power by more than 80% over the past 30 years. Now deployed in wind farms nationwide, these turbines owe their existence to National Lab research.

Created a pocket-sized DNA sampler.

A tool developed by National Lab scientists that identifies the microbes in air, water, and soil samples is fast becoming a workhorse in public health, medical, and environmental cleanup projects. Only a few years old, the credit-card-size PhyloChip is already pinpointing the diseases that kill coral reefs, and cataloging airborne bacteria over U.S. cities. It was also used to quickly categorize the oil-eating bacteria in the deep water plumes of the Deepwater Horizon spill.

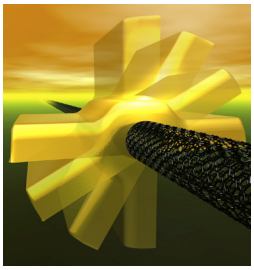
Revolutionized medical diagnostics.

From the original scintillation camera that detected gamma rays emitted by radioactive isotopes to today's cancer-detecting, compact nuclear-imaging devices and the magnets in MRI scanners—National Lab discoveries have revolutionized medicine and saved countless lives.

Redefined cancer therapy.

A proton accelerator that treats patients with advanced forms of cancer owes its existence to National Lab researchers, as does software that targets radiation treatments while sparing healthy tissue.

Fabricated the smallest machines.



The world's smallest synthetic motor, as well as radios, scales, and switches that are 100,000 times finer than a human hair, were engineered at a National Lab. These and other groundbreaking forays into nanotechnology could lead to life-saving pharmaceuticals and more powerful computers.

Improved airport security.

Weapons, explosives, plastic devices and other tools concealed by terrorists are easier to detect thanks to technology developed at a National Lab and now installed in airports worldwide.

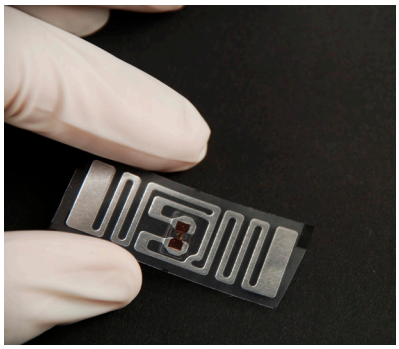
Preserved the sounds of yesteryear.

National Lab scientists engineered a high-tech way to digitally reconstruct aging sound recordings that are too fragile to play, such as Edison wax cylinders from the late 1800s. Archivists estimate that many of the millions of recordings in the world's sound archives, including the U.S. Library of Congress, could benefit from the technology.

Turned an additive green.

Found in everyday products such as antifreeze, paints and plastics, propylene glycol can now be produced from biomass instead of petroleum. The cost-competitive and renewable alternative process originated at a National Lab and is now in commercial use.

Transformed inventory control.



From finding, identifying and determining the condition of supplies loaded on ships to evaluating the readiness of battlefield munitions, inventory control has been simplified thanks to advanced radio-frequency identification tagging techniques devised by National Lab engineers and scientists.

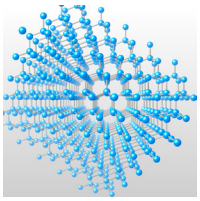
Solved a diesel dilemma.

A National Lab insight into how catalysts behave paved the way for a new, "lean-burn" diesel engine that met emissions standards and improved fuel efficiency by 25% over conventional engines.

Cemented a new material.

National Lab scientists have developed a novel and versatile material that blends properties of ceramic and concrete to form a nonporous product that can do everything from seal oil wells to insulate walls with extra fire protection. It even sets in cold weather.

Channeled chips and hips.



Integrated circuits and artificial hips owe their success to a National Lab discovery that revealed how to change a material by injecting it with charged atoms, called ions. Ion channeling is now standard practice in industry and science.

Built a better building.

The Department of Energy has built one of the world's most energy-efficient office buildings. The facility, operating as a living laboratory at a National Lab site, uses 50% less energy than required by commercial codes and only consumes energy produced by renewable power on or near the building.

Engineered smart windows.

National Lab scientists have created highly insulated windows that change color to modulate interior temperatures and lighting. If broadly installed, they could save about 5% of the nation's total energy budget.

Changed the face of matter.

Protons and neutrons were once thought to be indivisible. Wrong. National Lab scientists discovered that protons and neutrons were made of even smaller parts, called quarks. Later experiments identified six kinds of quarks, changing our view of how the material world works.

Harvested energy from air.

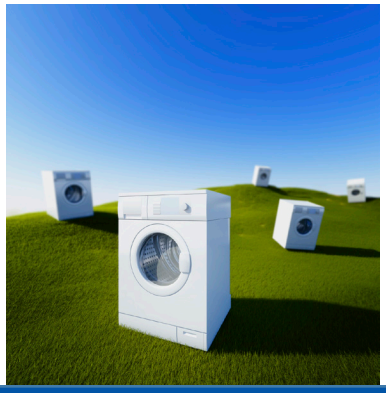
A miniature device—commercialized by private industry after a National Lab breakthrough—generates enough power from small temperature changes to power wireless sensors or radio-frequency transmitters at remote sites, such as dams, bridges and pipelines.

Simulated reality.

Trains, planes and cars and thousands of other objects are safer, stronger and better-designed thanks to computer simulation software first developed at a National Laboratory.

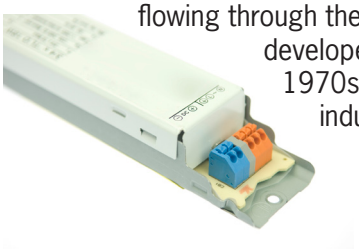
Gone grid friendly.

Regulating the energy use of household appliances, especially at peak times, could slash energy demand and avoid blackouts. A National Lab appliance-control device senses grid stress and responds instantly to turn off machines and reduce end-use demand, balancing the system so that the power stays on.



Given fluorescent lights their big break.

Chances are you're reading this using energy-efficient fluorescent lighting, and chances are those lights use electronic ballasts, which control the current flowing through the light. The ballast was developed at a National Lab in the 1970s with help from the lighting industry.



Put eyes in the sky.

Vela satellites, first launched in 1963 to detect potential nuclear detonations, transformed the nascent U.S. space program. The satellites featured optical sensors and data processing, logic and power subsystems designed and created by National Labs.

AMERICA'S NATIONAL LABORATORIES

U.S. DEPARTMENT OF ENERGY

The Ames Laboratory — Creating Materials & Energy Solutions — U.S. Department of Energy

Argonne National Laboratory

Berkeley Lab — Lawrence Berkeley National Laboratory

Brookhaven National Laboratory

Fermilab

Jefferson Lab — Thomas Jefferson National Accelerator Facility

Oak Ridge National Laboratory

Pacific Northwest National Laboratory — Proudly Operated by Battelle Since 1965

PPPL — Princeton Plasma Physics Laboratory

SLAC National Accelerator Laboratory

INL — Idaho National Laboratory

Lawrence Livermore National Laboratory

Los Alamos National Laboratory

NETL

NREL — National Renewable Energy Laboratory

Sandia National Laboratories

SRNL — Savannah River National Laboratory

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