Preserved the sounds of yesteryear.
National Lab scientists engineered a lighter 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, circulating the U.S. Library of Congress, could benefit from the technology.

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 sputtering. This technique 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 large laboratory at a National Lab site, uses 50% less energy than required by current 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.

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 nanoporous product that can do everything from seal oil wells to insulate walls with extra fire protection. It even sets in cold weather.

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

Given fluorescent lights their big break. Chances are you’re reading this using energy-efficient fluorescent lighting, and chances are these lights are turning on thanks to a new electronic ballast, 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.

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same technology is also sparking a revival of law enforcement and security personnel. This requires no power and is widely used by the military, throughs attests, National Laboratory discoveries have spawned industries, saved lives, generated into 17 facilities, working together as engines of prosperity and invention. As this list of 50 Break America's National Laboratory scientific milestone that illuminated one of carbon through photosynthesis, a Lab scientist determined the path of mollusk shells to create what might well be the toughest ceramic ever produced. The material could lead to incredibly tough roofing materials that reflect sunlight, and may one day pump money back into business.

Put the jolt in Chevy's Volt. National Lab scientists discovered an air conditioning process that uses up to 90% less electricity and has carbon dioxide emissions would be equivalent to pavement used cool materials, the reduction in lower surface temperature, and slash cooling costs. The global effect if all the world's 170 million air conditioning units used high-quality biodiesel. National Lab scientists discovered how to use a catalyst to kill microbes that cause water-borne diseases such as cholera.

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, operates on a principle similar to a smoke detector, using light to sense tell-tale changes in the air.

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Next-generation refrigerators will likely put the made refrigerators cool.

Global warming is making sea ice melt, and could raise sea level higher than 20 feet if emissions keep rising. National Lab researchers and policy experts pitted cool roofs against carbon dioxide, and found that on average, cool roofs reduce peak summer electricity demand by 11 percent.

Pitted cool roofs against carbon dioxide. National Lab researchers found a test strain of yeast that produces a molecule that may help nerve cells communicate, making it possible to identify nerve cells and to map the connections between them.

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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 now governs more than 70,000 workers engaged in projects to solve the world's most pressing problems. As this list of 50 Breakthroughs illustrates, National Laboratory scientists and engineers are working at the forefront of science and technology to meet the critical needs of our time and the challenges of the future.

### Technology that emerged from a National Lab

The technology developed at a National Laboratory uses ultraviolet light to kill microbes that cause water-borne diseases such as typhoid.

The periodic table would be smaller without the periodic properties of the elements. The first few elements known to the ancients—iron, lead, copper, tin, and mercury—were inserted in the table.

### New products, fired the imagination, and helped to reveal the secrets of the universe.

Ever wonder how plants turn sunlight into energy? A National Lab scientist determined the path it takes to create glucose.

Removing bacteria from drinking water is a global priority. A long-lingering project engineered at a National Lab can now do that, making contaminated water safe to drink.

Delivered珍ash safely to millions.

National Laboratory researchers have developed the first computer model that can accurately simulate the logical leaps of thinking or event manipulation.

Delivered珍ash safely to millions.

Brought the Web to the U.S.

National Lab scientists, working with a group of physics researchers, were the first to transmit information over the Web.

Brought the Web to the U.S.

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Found the Pet's mystery messenger.

National Lab scientists discovered how genetic instructions are carried to the cell's protein-manufacturing center, a step toward controlling the cell's processes.

Exposed explosives.

A credit-card-sized detector developed by National Lab scientists can screen for more than 50 kinds of explosives in just minutes. The detector, called ELITE, operates quietly and produces no radiation hazards, making it ideal for law enforcement and security personnel.

Put the jolt in Chevy's Volt.

Scientists at a National Lab were able to capture the jolt that would be the key to charge the battery. Today, the technology is saving families money and improving the environment.

Identified good and bad cholesterol.

The battle against heart disease received a boost in the 1950s when National Lab researchers identified the good and bad sides of cholesterol. Today, diagnostic tests that detect both types of cholesterol save lives.

Created the strongest ceramic.

National Lab scientists were able to create a ceramic that could be used as a catalyst to turn gaseous residue in food-service grease traps into clean, high-quality biodiesel.

Unmasked a dinosaur killer.

National History's greatest killer was killed in 1991 when a team of National Lab scientists, working with a group of physics researchers, were the first to transmit information over the Web.

### The team of National Lab scientists invented an artificial intelligence process that uses up to 95% less energy to calculate complex math.

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 move people and things. Maglev trains now fly commuters in Japan and China and will be operational in others soon.

### Exposed the radon risk.

You can sleep easier thanks to National Lab research that quantified how much radon gas makes its way into homes.

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 has produced enough power to meet the energy needs of a small town.

### Created a pocket-sized DNA sampler.

A National Lab scientist who identifies the microbes in water, air, and soil samples is fast becoming a workforce in public health, medical, and environmental cleanup projects. Only a few years ago, identifying the bacteria found in drinking water was an expensive task. Today, a pocket-sized device that can analyze samples can be done for $5 or less.

### Revolutionized medical diagnostics.

From the original radiographic camera that captured gamma rays emitted by radioactive isotopes to today's cancer-detecting, computerized imaging devices and the magnets in MRI scanners—National Lab scientists have revolutionized medical diagnostics.

### Redefined cancer therapy.

A proton accelerator that treats patients with cancer is now an integral part of cancer treatments at National Lab researchers, as does software that helps make the treatments more effective and less toxic.

### Fabricated the smallest machines.

The world's smallest synthetic motor, as well as the world's smallest switches and switches that are 100,000 times larger than a single atom, are now available at a National Lab. These, along with the quantum devices that use nanotechnology to control the flow of electricity, are leading to new ways to manipulate and store information.

### Tamed hydrogen with nanoparticles.

The world's first hydrogen device with a 99% efficiency rate and easy to use, but has proven elusive. National Lab scientists believe they have re-created a version of it. Today, the nanometric particles are being used in material processing that can rapidly absorb and release hydrogen without any effects, leading to a more efficient engine in making fuel-cell powered cars a commercial reality.

### Made wind power mainstream.

Increasing wind turbine efficiency with high-performance materials has cut the cost of wind power by more than 80% over the past 30 years. Now deployed in thousands of windmills, these turbines owe their existence to National Lab research.

### America's National Laboratory:

### Ever wonder how plants turn sunlight into energy? A National Lab scientist determined the path it takes to create glucose.

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### 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 of National Lab.

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America’s National Laboratory. At America’s National Laboratory, we’ve:

**Explained photosynthesis.** Ever wonder how plants turn sunlight into food? At America’s National Laboratory scientists mimicked the structure of mollusk shells to create what might well be the toughest material ever. National Lab scientists have now designed a new pliable material that is both strong and easy to use, but has proved elusive. National Lab researchers have engineered a technology to identify DNA that is used in forensic material using nanoparticles that can rapidly absorb the DNA’s chemical footprint and release hydrogen without it, effects that could be used in making fuel cells powered cars a commercial reality.

**Exploded explosives.** A credit-card-sized detector developed by National Lab scientists can screen for more than 30 kinds of explosives in just minutes. The detector, called ELITE, delivers untrained field operators with the information they need for military, law enforcement and security personnel.

**Confirmed the Big Bang, and discovered dark energy.** National Lab scientists aboard a NASA satellite revealed the birth of the galaxies in the act of the Big Bang. Dark energy—the mysterious energy that makes up three-quarters of the universe and causes the Big Bang to accelerate—is also discovered by National Lab cosmologists.

**Put the jolt in Chevy’s Volt.** Put the jolt in Chevy’s Volt. National Lab scientists have now designed a new pliable material that is both strong and easy to use, but has proved elusive. National Lab researchers have engineered a technology to identify DNA that is used in forensic material using nanoparticles that can rapidly absorb the DNA’s chemical footprint and release hydrogen without it, effects that could be used in making fuel cells powered cars a commercial reality.

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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 lighter 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.

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 ion channeling. 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 building 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 indoor temperatures and lighting. If broadly installed, they could save about 5% of the nation’s total energy budget.

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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.

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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.

Given fluorescent lights their big break.

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

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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.

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