APS physics

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Rebuilding Science Infrastructure Would Create Jobs, Keep U.S. Competitive

By Michael S. Lubell

Putting Americans to work building roads and bridges can help a flagging economy, but some analysts caution that many projects could take up to 18 months to get started. Beginning to rebuild America's science infrastructure not only can be done faster and provide jobs for factory and construction workers now, but it can also put our nation on a 21st century innovation path that will keep America competitive for decades to come.

For years, we have been underinvesting in our university laboratories and national scientific user facilities. Research equipment is obsolete and buildings are in disrepair. As a result, we are no longer attracting the best and brightest students to careers in science and engineering. Europe and Asia are getting ready to eat our innovation lunch.

Lack of financing has forced many cutting-edge projects at our universities and national laboratories to be shelved, even though they have been fully designed and are ready to go right now. Giving them the dollars they require will create more than 15,000 jobs directly and at least 25,000 in the aggregate, most of them in the manufacturing and construction sectors, which have been hit hard by layoffs.

Courtesy of Brookhaven National Laboratory

National Synchrotron Light Source (NSLS) in Brookhaven, New York

Getting blue-collar workers working again will boost consumer spending and ease the nation's economic ills. Rebuilding our scientific infrastructure will boost our technological capacity and spur economic growth.

Drawing connections between blue-collar jobs and science spending may sound odd, but it's easy to do. Here are just a few examples involving three key federal agencies: the Department of Energy, the National Institute of Science and Technology and the National Science Foundation.

Among its mandates, the Energy Department has responsibility for designing, building and operating major scientific user facilities. The National Synchrotron Light Source (NSLS) at Brookhaven National Laboratory on Long Island in New York State is one of them. For more than 25 years, it has provided extraordinary opportunities for researchers from industry and universities to push the technological envelope and probe scientific frontiers, from studies of breast cancer and Alzheimer's disease to improvements in solar cells and computer memory.

But the facility is no longer

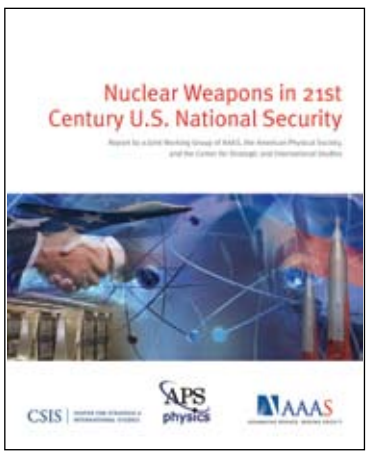
REBUILDING continued on page 3

APS/AAAS/CSIS Report Examines Nuclear Weapons Policy

By Ernie Tretkoff

Preventing the spread of nuclear weapons, securing and reducing global stockpiles of them and engaging Russia in a new strategic dialogue are pressing issues facing the next presidential administration, according to a jointly released report by APS, the American Association for the Advancement of Science (AAAS) and the Center for Strategic and International Studies (CSIS).

Titled *Nuclear Weapons in 21st Century U.S. National Security*, the report was developed following four workshops held last year. Three covered separate tracks: technical, military and international. Experts from the scientific, defense and diplomatic policy communities participated in the workshops. The fourth one combined results from the three tracks.



"Renewed interest in U.S. nuclear policy was stimulated in the past year through a series of editorials by distinguished statesmen and by the appointment of a congressional commission to look into these matters," said John Browne, an author of the report and former director of Los Alamos National Laboratory.

"This report identifies a possible way to bring together disparate views regarding the appropriate role of U.S. nuclear weapons in our 21st-century defense strategy. We identify the opportunity to pursue a parallel approach that regains leadership in global nuclear nonproliferation through a series of initiatives while continuing to refurbish and update our nuclear stockpile and infrastructure as necessary without creating any new nuclear weapon capabili-

POLICY continued on page 3

Nobel Laureate Physicist Steve Chu Named Next U.S. Energy Secretary

APS Lauds President-Elect Obama's Choice of Lawrence Berkeley National Laboratory Director, World Energy Research Leader

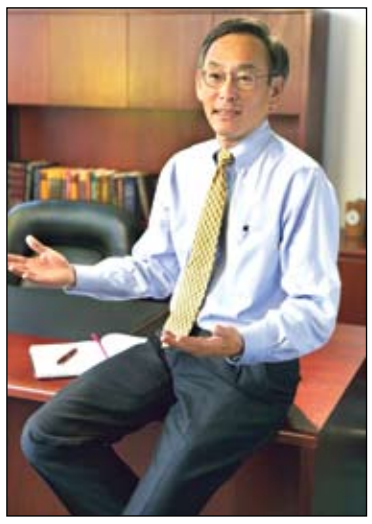
By Tawanda W. Johnson

The American Physical Society (APS) is elated that President-Elect Obama has nominated Nobel Laureate Steve Chu, a renowned physicist, a world leader in alternative and renewable energy research and Lawrence Berkeley National Laboratory director, as the next U.S. Energy Secretary.

"Dr. Chu is a man of great intellect whose scientific accomplishments make him an outstanding selection for U.S. Energy Secretary. As the Obama administration develops its energy policy, Dr. Chu will be an effective leader in marshaling basic and applied research to strengthen U.S. energy security and tackle the devastating effects of global warming," said APS President Arthur Bienenstock.

Chu was the recipient of two prestigious APS prizes, the Herbert P. Broida in 1987 and Arthur L. Schawlow in 1994, for his extraordinary work of developing methods to cool and trap atoms with laser light. In 1997 while at Stanford University, Chu was one of three scientists to win the Nobel Prize in physics for that same work. Since 2004, he has served as director of the Lawrence Berkeley National Laboratory, which has 4,000 employees and a budget of $650 million.

Under his leadership, the lab has become a center for research into biofuels and solar energy technologies. A lifetime member and fellow of APS, Chu has been a staunch advocate of energy efficiency and alternative energy research, stating that the U.S. should rid its dependence on foreign oil to combat global warming.



Courtesy of Lawrence Berkeley National Laboratory

Steve Chu

He was also the driving force behind the development of the Energy Biosciences Institute, a $500 million pact between BP, University of California, Berkeley, Berkeley National Lab and the University of Illinois. Additionally, he was the leading organizer of the Joint BioEnergy Institute, one of three Bioenergy Research Centers funded by the U.S. Department of Energy.

Capitol Hill Quarterly is a publication of the American Physical Society, www.aps.org. APS is a non-partisan, professional society of physicists with more than 46,000 members.

SESAME Officially Opens In Middle East

SESAME, a synchrotron radiation laboratory in the Middle East, opened with an inauguration ceremony Nov. 3, attended by Prince Ghazi bin Mohammad of Jordan (left) and Koichiro Matsura, director-general of the United Nations Educational, Scientific and Cultural Organization (UNESCO) (right).

Located in Allan, Jordan, SESAME is a UNESCO-sponsored project that promotes scientific development as well as understanding and cooperation among scientists from different countries in the Middle East. The November ceremony marked the completion of the main building for SESAME and scientific operations are expected to begin in 2011.

Courtesy of SESAME

Jordanian Prince Ghazi bin Mohammad (left) watches as Koichiro Matsura (right), Director-General of UNESCO, cuts the ribbon signifying the launch of the SESAME facility. Standing between them is the Director of SESAME, Khaled Toukan.

The project will offer facilities for interdisciplinary scientific collaboration and promote basic and applied research in the Middle East. Herman Winnick, a long-time APS member who currently serves on the APS Committee on International Scientific Affairs, was among the people who proposed SESAME and has been instrumental in promoting it.

On the Back Page

U.S. Rep. Ellen O. Tauscher discusses controlling nuclear fuel in a new energy era.

APS Members in the Media

"We don't want this to be another Lee Harvey Oswald case where the public says it is never solved to their satisfaction."

***Rush Holt**, on the anthrax investigation,* Los Angeles Times, **(NJ-12th)** *August 8, 2008*

"We like to think that we are re-writing our children's science textbooks. In the same way that Galileo revolutionized our thinking about our place in the universe, we hope our discoveries will give us new insight into mankind's place in the universe."

***Michael Barnett**, Lawrence Berkeley National Laboratory,* The Newshour with Jim Lehrer online, **(CA-9th)** *August 8, 2008*

"If 96 percent of the stuff in the universe is foreign to us, it's pretty interesting for us to ask what that is."

***Gary Hinshaw**, NASA, on dark energy,* The Washington Post, **(MD-5th)** *September 26, 2008*

"Real breakthroughs are not found because you want to develop some new technology, but because you are curious and want to find out how the world is."

***Anton Zeilinger**, University of Vienna, on quantum cryptography,* BBC News Online, *October 9, 2008*

"The bottom line is it's a wonderful experiment, but it needs to be approached carefully, or you go out of business."

***Fred Dylla**, American Institute of Physics, on open access journals,* The Boston Globe, **(MD-5th)** *August 21, 2008*

"Scientifically, it is a compelling problem, and the public accepts the notion that it's a problem. But at the moment most people are feeling affected by other things in a much more urgent fashion."

***Michael Lubell**, APS, on climate change,* St. Louis Post-Dispatch, **(NY-15th)** *October 22, 2008*

"This is the first time, as far as I know, that both major candidates for president have responded to a set of questions about science for the public. Both responses are more comprehensive than I had expected."

***Lawrence Krauss**, Arizona State University, on Science Debate 2008,* The Cleveland Plain Dealer, **(AZ-5th)** *September 19, 2008*

"The core message is we need a comprehensive energy strategy. Nuclear energy can and should be a part of that overall comprehensive energy strategy, but nothing can happen without the human resources."

***Shirley Jackson**, Rensselaer Polytechnic Institute,* Associated Press, **(NY-21th)** *October 6, 2008*

Snapshots from Physics History

October 1958: Physicist Invents First Video Game

In October 1958, William Higinbotham, a physicist, created what is thought to be the first video game. It was a very simple tennis game, similar to the classic 1970s video game Pong, and it was quite a hit at a Brookhaven National Laboratory open house.

Higinbotham was born on Oct. 25, 1910, in Bridgeport, Conn. and grew up in Caledonia, N.Y.

He graduated from Williams College in 1932 and pursued a graduate degree in physics at Cornell University. While a graduate student, he worked as an electronics technician. In 1941, he joined the Massachusetts Institutes of Technology's Radiation Lab, where he worked on cathode ray tube displays for radar systems. In 1943, he moved to Los Alamos to work on electronics for a timing system for the atomic bomb.

In 1948, he joined Brookhaven National Laboratory's instrumentation group and served as its leader from 1951 to 1968.

During that time, in October Brookhaven held annual visitors' days during which thousands of people toured the lab. Higinbotham was responsible for creating an exhibit to show off the instrumentation division's work.

Most of the existing exhibits were rather dull. Higinbotham thought he could better capture visitors' interest by creating an interactive demonstration. He said in a magazine interview that "it might liven up the place to have a game that people could play and which would convey the message that our scientific endeavors have relevance for society."

The instrumentation group had a small analog computer that could display various curves, including the path of a bouncing ball on an oscilloscope. It took Higinbotham only a couple of hours to conceive the idea of a tennis game and a few days to organize the basic pieces. Having worked on displays for radar systems and many other electronic devices, Higinbotham had no trouble designing the simple game display.

He made some drawings, and blueprints were drawn up. Technician Robert Dvorak spent about two weeks building the device. After a little debugging, the first video game was ready for its debut. Its name: Tennis for Two.

Players could turn a knob to adjust the angle of the ball and push a button to hit the ball toward the other player. As long as they pressed the button when the ball was in their court, players couldn't actually miss the ball, but if they hit it at the wrong time or the wrong angle, the ball wouldn't make it over the net. Balls that hit the ground bounced like a real tennis ball. When the ball went off the court or into the net, players hit a reset button to start the next round.

Tennis for Two had none of the fancy graphics video games use today. The cathode ray tube display simply showed a side view of a tennis court represented by just two lines – one representing the ground and one representing the net. The ball was just a dot that bounced back and forth. Players also had to keep score for themselves.

The game circuitry was fairly simple, using mostly resistors, capacitors and relays, though it did use transistors for the fast switching needed when the ball was in play.

Visitors loved it. It quickly became the most popular exhibit, with people standing in long lines to get a chance to play.

The first version, used in the 1958 visitors' day, had an oscilloscope with a tiny display, only 5 inches in diameter. The next year, Higinbotham improved it with a larger display screen. He also added another feature: The game could now simulate stronger or weaker gravity, so visitors could play tennis on the moon, Earth or Jupiter.

After two years, Tennis for Two was retired. The oscilloscope and computer were taken for other uses, and Higinbotham designed a new visitors' day display that showed cosmic rays passing through a spark chamber.

Higinbotham, who had already patented 20 inventions, didn't think his tennis game was particularly innovative. Although he noticed that the Brookhaven visitors liked the game, he had no idea how popular video games would later become. If he had had the foresight to patent the game, the federal government would have owned the patent since he worked for a U.S. laboratory. Therefore, he wouldn't have made any money from it.

"It never occurred to me that I was doing anything very exciting. The long line of people, I thought, was not because this was so great but because all the rest of the things were so dull," he once said.

Tennis for Two was more or less forgotten for some time. In 1964, Sanders Associates received the first patent for a video game. Magnavox bought the patent and produced video game systems beginning in the early 1970s. Competitors wanting to break the Magnavox patent found out about Higinbotham's earlier video game, and he was called to testify, but the case was settled out of court. Higinbotham only became well known as the inventor of the video game after an article appeared in *Creative Computing* magazine in 1982.

Higinbotham's main interest throughout most of his career was not video games, but nuclear arms control. He helped found the Federation of American Scientists and served as its first chairman and executive secretary. Higinbotham died in November 1994. He is more known for the development of the video game than his work on nonproliferation.

Further reading: http://www.bnl.gov/bnlweb/history/higinbotham.asp; Flatow, Ira. *They All Laughed... from light bulbs to lasers: the fascinating stories behind the great inventions that have changed our lives.* HarperCollins, 1993.

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Four APS Members Among Honorees Who Receive National Medal of Science

By Ernie Tretkoff

Four APS members are among the recipients of the 2007 National Medal of Science, and one APS member is among the recipients of the 2007 National Medal of Technology. The awards honor the nation's top scientists and innovators.

President Bush presented the medals during a ceremony at the White House last fall.

APS members Mostafa El-Sayed of Georgia Institute of Technology; Fay Ajzenberg-Selove of the University of Pennsylvania; Charles Slichter of the University of Illinois, Urbana-Champaign; and David Wineland of the National Institute of Standards and Technology received the National Medal of Science.

El-Sayed was cited "for his contributions to our understanding of the electronic and catalytic properties of nanostructures and nanomaterials."

Ajzenberg-Selove was noted "for her contributions in nuclear physics that have advanced research into applications, including energy generation from fusion, dating of artifacts and nuclear medicine."

Courtesy of
The National Science Foundation

Slichter was cited "for establishing nuclear magnetic resonance as a powerful tool to reveal the fundamental properties of molecules, liquids and solids, enabling the development of numerous modern technologies."

Wineland was noted "for his outstanding leadership in the science of laser cooling and manipulation of ions that have had multiple applications in modern physics."

In related news, APS member C. Grant Willson of the University of Texas at Austin was among the recipients of the 2007 National Medal of Technology. He created novel lithographic imaging materials and techniques that have enabled the manufacturing of smaller, faster and more efficient microelectronic components. The National Science Foundation administers the National Medal of Science, which was established by Congress for the White House in 1959. The National Medal of Technology was established in 1980.

LaserFest to Celebrate 50 Years of Laser Innovation

By Ernie Tretkoff

The APS has joined with the Optical Society of America (OSA) to plan LaserFest, a multi-year series of events and activities centered around 2010 as the commemoration of the 50th anniversary of the laser invention in 1960.

"Every time we give a presentation using a laser pointer, see a laser light show, watch a DVD or benefit from bloodless surgery or laser eye correction, we are profiting from the work of our colleagues who were the founders of this technology," said APS President Arthur Bienenstock and OSA President Rod Alferness in a joint statement.

When it was first invented, the laser was called a "solution looking for a problem." Today, the laser is used as a scientific research tool and in thousands of commercial applications, ranging from barcode scanners to laser surgeries.

The laser was not discovered from a single breakthrough by one individual, but from a series of developments. Albert Einstein in 1917 presented the concept of stimulated emission, which was later experimentally verified. The maser, a precursor to the laser, was developed in 1954 by Charles Townes and independently verified by Nicolay Basov and Alexandr Prokhorov. Townes and Arthur Schawlow published an important paper on the theory of the laser in *Physical Review* in 1958, which led to the first patent for a laser awarded in March 1960, followed by the first demonstration of a working laser two months later by Theodore Maiman at Hughes Research Lab.

To celebrate the laser, APS and OSA are planning a variety of events at the local and national levels to reach students, teachers, policy makers and the public. A website devoted to LaserFest (LaserFest.org) includes information about the laser, an up-to-date list of LaserFest events and instructions on how to participate in the events.

Educational activities such as PhysicsQuest, an APS activity kit for middle school students, will have a laser theme for 2009-2010. APS plans to develop additional educational materials, including posters for classrooms, a laser-themed activity book for young children and videos.

Throughout the year, public lectures, symposia, debates, laser shows and demonstrations will highlight the laser's history and applications. OSA will encourage its student chapters to organize laser days to be held in communities, schools and on college campuses. Chapters of the Society of Physics Students are also expected to participate in organizing events. APS and OSA will each contribute resources and are seeking additional funding from the National Science Foundation and Department of Energy for LaserFest.

Many LaserFest activities will take place during 2010, although OSA has begun hosting some events. A symposium honoring Maiman, who died in 2007, was held in San Jose last year at the Conference on Lasers and Electro-Optics/International Quantum Electronics. In October, the Schawlow-Townes Symposium on 50 Years of the Laser, marking the 50 anniversary of the publication of the classic paper by Schawlow and Townes [Infrared and Optical Masers, *Phys. Rev*. 112, 1940 (1958)] was held in conjunction with the Frontiers in Optics/APS Division of Laser Science meeting in Rochester, N.Y. The symposium featured a presentation by Charles Townes on the early history of the laser.

REBUILDING continued from page 1

state-of-the-art, and it needs to be replaced. The design and engineering of its successor, the NSLS-II, was completed in 2007, but groundbreaking and construction have been delayed for lack of federal funds. If Congress appropriates the $82 million the project needs to move forward, almost 1,000 manufacturing and construction jobs could be created within 120 days.

The global fusion energy project, ITER, offers an unusual opportunity to create jobs in the Rust Belt. Although the United States entered into an international agreement to participate in ITER, which is being constructed in France, Congress thus far has failed to provide the money required for our nation to meet its obligations. High on the U.S. priority list is $89 million worth of stainless steel, beryllium and other metals that Mid-western industries could supply, providing 1,000 jobs in an area of the country that is suffering most.

In all, the Energy Department has more than $1.1 billion in projects sitting in the funding queue. Financing them would directly generate more than 10,000 jobs.

The National Institute of Standards and Technology has more than $67 million in construction projects ready for a funding go-ahead and more than $100 million in "green" manufacturing partnerships waiting for congressional appropriations. More than 1,000 jobs hang in the balance.

Finally, the National Science Foundation, which supports a large fraction of our nation's university based research, has more than $200 million in requests for science instrumentation that it would like to fund but cannot. Add $120 million for the Alaska Region Research Vessel, which would employ idle American shipyard workers, and more than 3,000 unemployed people would be put to work.

At a time when Washington is spending $700 billion to prop up Wall Street and is preparing to inject another $500 billion as an economic stimulus, committing $1.5 billion to science infrastructure is not too much for Congress and the White House to consider.

POLICY continued from page 1

ties," said Browne.

"Such a 'centrist' approach as outlined by this paper has been lacking, causing our nuclear policy to drift for a decade or more."

To re-establish the U.S. role as a leader in nonproliferation, the report seeks to identify a package of nuclear initiatives, including ratification of the Comprehensive Test Ban Treaty. The U.S. should also address the challenge of expanding use of nuclear energy without increasing proliferation risks. Some possible initiatives toward addressing that challenge include creating an international fuel bank, developing advanced technical safeguards and closing a loophole in the nonproliferation treaty, the study states.

"To re-establish the U.S. role as a leader in nonproliferation, the report seeks to identify a package of nuclear initiatives, including ratification of the Comprehensive Test Ban Treaty," the report states.

Opinions differed on the importance of nuclear weapons for security, but the study group participants generally agreed that the U.S. needs a credible nuclear deterrent.

Refurbishing and updating the nuclear stockpile and infrastructure as necessary without creating any new nuclear weapon capabilities could increase confidence in the reliability of our nuclear weapons, thereby making it possible to reduce the total inventory while maintaining a credible nuclear deterrent, the report states.

The report seeks to identify a "spectrum of options" to refurbish and update the stockpile, considering each system on an individual basis. There is no immediate need to commit to any particular program, the report states. The nuclear weapons laboratory directors continue to certify annually the current stockpile as safe, reliable and secure.

"In this approach, the president will be assured that our deterrent force is safe, secure and reliable as long as it is needed, regardless of its size. This would enable new efforts to engage other nations in reducing global arsenals and strengthening efforts against nuclear terrorism," said Browne.

To maintain a credible nuclear deterrent, the U.S. also needs to sustain the necessary human capital, the report states, explaining that "expertise and competence is declining across the nuclear enterprise." A broader mission for the nuclear weapons labs to include energy and nuclear security can help recruit scientists and engineers, the report states.

"The next step after the release of our report is to discuss these issues with appropriate audiences within the government, the defense and scientific communities, hopefully to stimulate action in the next administration," said Browne.

To read the report, log onto http://www.aps.org/policy/reports/popa-reports/index.cfm.

The Back PAGE

Controlling Nuclear Fuel In A New Energy Era

By Congresswoman Ellen O. Tauscher

Among the challenges facing the new Congress and President-elect Barack Obama, none is quite as daunting as the exploding global demand for energy – one that is leading many nations to pursue nuclear power.

Regrettably, our current tools and norms are woefully insufficient for channeling the demand for nuclear power into safe and secure outcomes.

We need new ideas that make nuclear energy accessible to emerging nations but prevent the creation of new nuclear weapons programs. That is why I support a new international, multilateral compact that would offer safe and reliable electricity through nuclear power, while keeping the most sensitive parts of the fuel cycle under the supervision of the International Atomic Energy Agency (IAEA).

"Regrettably, our current tools and norms are woefully insufficient for channeling the demand for nuclear power into safe and secure outcomes."

Just three weeks ago, Secretary of Defense Robert Gates spoke about the goal of continuing to "keep the number of nuclear states as limited as possible." This same goal was outlined in the June 2008 National Security Strategy.

However, the global arms control regime is under siege, in part, from the ever increasing demand for low-cost nuclear energy. Nuclear energy has a number of advantages: it's carbon free and provides reliable electricity; its price is generally stable; and it can help create potable water and hydrogen.

The IAEA expects global nuclear power capacity to double by 2030.

Fifty countries have expressed interest in nuclear power and have asked the IAEA for technical guidance. Currently, 439 nuclear power reactors operate in 30 countries, with 36 new plants under construction. Of the reactors under construction, 17 are in developing countries with varying levels of security.

Unfortunately, building nuclear power plants gives countries access to weapons material. The United Nations warns that of the 60 states currently operating or constructing nuclear power or research reactors, at least 40 possess the industrial and scientific infrastructure to build nuclear weapons on relatively short notice. Once countries master uranium enrichment and plutonium separation, they have overcome a significant hurdle to developing nuclear weapons.

Furthermore, the National Academy of Sciences reports global stocks of plutonium are increasing. Additionally, nuclear energy creates disposal and spent fuel management challenges. Most startling, IAEA Director General El Baradei recently reported that there had been nearly 250 incidents of theft or loss of nuclear material from June 2007 to June 2008.

"It's time for a new international compact, one that would guarantee safe and reliable electricity through nuclear power and keep the most sensitive parts of the fuel cycle under IAEA supervision."

These are serious threats to global security. The instability created by the drive for nuclear energy is a direct threat to the world's nuclear nonproliferation efforts. Not coincidentally, potentially hostile countries have learned the best way to get the world's attention is to start a nuclear weapons program.

It's time for a new international compact, one that would guarantee safe and reliable electricity through nuclear power and keep the most sensitive parts of the fuel cycle under IAEA supervision.

There has been some progress on this issue, most notably

from the director general of the IAEA and the Nuclear Threat Initiative, which has raised funds to create a low-enriched uranium stockpile. Now the world should begin a serious pursuit of a multilateral fuel cycle compact and a new nonproliferation bargain.

With an Obama administration, a new opportunity to deal with this issue has finally arrived. At the heart is the idea that there is no absolute need for countries to possess their own enrichment or reprocessing facilities, the two most sensitive stages of the fuel cycle. One of the most interesting ideas being considered is a fuel bank overseen by the IAEA.

The setup would be rather straight-forward.

The IAEA would maintain a regular supply schedule and ensure prompt payment. As a guarantor, the IAEA would provide oversight. It would judge whether conditions for supply are being met, assess the nonproliferation status of the recipient, oversee suppliers and generally act as a broker between the supplier and recipient.

To make this model possible, I will work with President-elect Obama to undertake several steps in the short term. The most immediate is a new commitment by the United States to lead negotiations toward a fissile material cutoff treaty.

This is a must-have.

We agreed to this commitment during the 2000 Nuclear Non-Proliferation Treaty (NPT) Review Conference. Under the treaty, production of fissile material would end, and all enrichment and reprocessing facilities in nuclear weapons states would be subject to international verification. Following through on this agreement would make it easier to manage the fuel cycle and reduce the risk of theft of nuclear material.

Additionally, we must establish clear penalties for withdrawal from the Nonproliferation Treaty. It took three years for the international community to condemn North Korea after it withdrew from the NPT in 2003. Instead of being allowed to act with impunity, I recommend that the Security Council prospectively adopt a resolution under Chapter 7 that states that if a nuclear power, after being found by the IAEA to be in noncompliance with its safeguard commitments, withdraws from the NPT, such a withdrawal would then automatically trigger sanctions.

The U.S. should also immediately ratify the Comprehensive Test Ban Treaty. The United States Senate's failure on yet another commitment undertaken under the NPT directly undermines U.S. leadership on nonproliferation.

Furthermore, the U.S. needs to engage in immediate and unconditional direct negotiations with North Korea and Iran, the two rogue nations who are currently posing the greatest threat to nuclear nonproliferation. In both cases, the new administration should lay out clear options for normalizing relations. We could offer membership in a new multilateral fuel cycle compact in return for normalized status. If both countries reject an option that gives them the ability to pursue peaceful nuclear energy, then there will be clear and credible grounds for more forceful action.

In addition, the Proliferation Security Initiative needs strengthening and an independent budget. Needless to say, this isn't an exhaustive list of steps, and such an enterprise will not be easy. Outstanding questions and challenges remain–challenges that scientists around the world will play a key role in solving.

Can we find a safe and reliable way to transport nuclear materials?

How can we promote a balance in energy production around the world, avoiding an over reliance on nuclear energy? And most importantly, how can we dispose of the waste products nuclear energy production creates?

The American Physical Society examined some of those questions in its 2005 report, *Nuclear Power and Proliferation Resistance: Securing Benefits, Limiting Risk*. The report identified some key technical challenges for scientists to work on, including advanced technical safeguards and proliferation resistant reactors.

The ever-present threats around the globe mean the clock is ticking. I believe the United States must take a key leadership role in making a multilateral fuel cycle compact a reality, thus reducing the threat from nuclear proliferation.

U.S. scientists who work in academia, in private business and in our national laboratories have a big role to play. And that is one of the reasons why I am very proud that the district I have represented since 1996–California's 10th Congressional district–is the only district in the country that is home to two national laboratories: Lawrence Livermore and Sandia-California, which have a combined workforce of about 7,900 people.

"As a nation facing many challenges, we will undoubtedly continue to rely on scientists to find answers to our most pressing problems, including addressing the technical issues that will ensure the peaceful use of nuclear energy and reduce proliferation."

Researchers across the spectrum of disciplines, studiously and without great fanfare, strive each and every day to advance our knowledge of the world inside a scientific laboratory. It is there where we construct the world's fastest supercomputers and study global climate change. It is there where we house powerful lasers to study the beginnings of the cosmos and reproduce the power of the sun. As a nation facing many challenges, we will undoubtedly continue to rely on scientists to find answers to our most pressing problems, including addressing the technical issues that will ensure the peaceful use of nuclear energy and reduce proliferation.

Congresswoman Ellen O. Tauscher is currently serving her sixth term representing California's 10th Congressional district, which includes San Francisco's suburbs in Contra Costa, Alameda and Solano counties. In Congress she is a leader on defense, homeland security, high-tech, transportation and veterans' issues and is known as one of Congress's leading experts on nuclear nonproliferation.