APS physics

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APS Hails President Obama's American Science Innovation Strategy

By Tawanda W. Johnson

The American Physical Society commends President Obama's commitment to prepare America for a 21st-century economy by investing in research and development – the building blocks of innovation, leading to technological advancements, job growth and improved lives for all Americans.

During a recent trip to Troy, N.Y., the President reaffirmed his bold agenda to keep the nation on a path of sustained economic growth and shared prosperity, including restoring America's leadership in fundamental research. "It was basic research in physics that would eventually produce the CAT scan," said Obama during his speech at Hudson Valley Community College.

To achieve his goals of fostering new jobs, businesses and industries, the President pledged to do the following:

• Enact the largest R&D increase in our nation's history. With $18.3 billion in research funding, the Recovery Act is part of the largest annual increase in research and development in America's history.

• Double the R&D budget of key science agencies. The President's budget proposed to double the research budgets of the Department of Energy's Office of Science, the National Science Foundation and the National Institutes of Standards and Technology.

• Invest 3 percent of the Gross National Product (GNP) in R&D. The President has proposed a goal that as a country, we invest more than 3 percent in GDP in public and private research and development – exceeding the level achieved at the height of the space race.

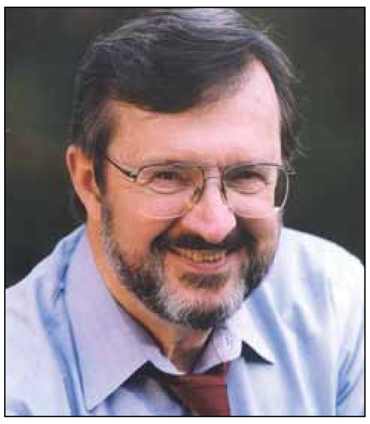
"APS is thrilled that President Obama has made a strong commitment to research and development so early in his term, and the Society is eager to support him on this path throughout the rest of his term," said Michael S. Lubell, APS Director of Public Affairs.

House Appropriations Chairman Honored for Science, Engineering, Technology Leadership

By Chris McManes
IEEE-USA

U.S. Rep. David Obey, chairman of the House Appropriations Committee, was recently honored for his leadership and commitment toward the United States remaining a global leader in science and innovation.

Obey received the George E. Brown Jr. Science, Engineering and Technology Leadership Award in a ceremony on Capitol Hill. IEEE-USA President Gordon Day presented the award on behalf of the Science, Engineering and Technology Work Group (SETWG)–a network of professional, scientific and engineering societies, higher education associations, companies, institutions of higher learning and trade associations. It is concerned about the future vitality of the U.S. science, mathematics and engineering enterprise.



U.S. Rep. David Obey

Before the passage of the American Recovery and Reinvestment Act in February, Obey spoke on the House floor about investing "in new portions of the economy through science, technology [and] new energy initiatives to try to modernize the economy and make it stronger."

Obey supported these initiatives by providing funding for: competitive construction grants for research science buildings at colleges, universities and other research organizations; a reliable and efficient electricity delivery system – Smart Grid – that includes research & development, pilot projects and federal matching funds to modernize the electricity grid; National Science Foundation grants to put scientists to work and keep promising younger researchers in the pipeline; and investments in cutting-edge research infrastructure and instrumentation.

House Speaker Nancy Pelosi Named Legislator of the Year

By Tawanda W. Johnson

Speaker Nancy Pelosi

APS recently celebrated U.S. House Speaker Nancy Pelosi being named Legislator of the Year by the Task Force on American Innovation, a coalition of businesses, trade associations, scientific societies and higher education organizations that advocate for greater investments for basic research in the physical sciences and engineering. APS is a founding member of the Innovation Task Force.

"Nancy Pelosi was a champion of science research and education long before it was politically fashionable, and she left her indelible mark on the budgets Congress passed this year that contained unprecedented increases for science," said Michael S. Lubell, Director of APS Public Affairs.

Craig Barrett, retired chairman of Intel Corp., presented the Speaker with the award during a reception at The Capitol Visitor Center. Attendees included U.S. Rep. Anna Eshoo (CA-14th); U.S. Rep. Bart Gordon (TN-6th), chairman of the House Science & Technology Committee; and Norman Augustine, retired CEO and chairman of Lockheed Martin Corp. Barrett credited the Speaker with "artfully using her power, persuasion and pushiness" to achieve funding increases in the physical sciences and engineering. Specifically, he said Pelosi's Innovation Agenda and support of the America COMPETES Bill and the American Reinvestment and Recovery Act, among other initiatives, led to funding increases for science.

A staunch supporter of science, the Speaker is known for stating that "science, science, science, science" is the solution to challenges facing the nation, said Barrett who added that "Pelosi, Pelosi, Pelosi, Pelosi" is the key to funding science.

"It is a great honor to receive this award in the presence of two champions of innovation and science funding in the Congress – Chairman Bart Gordon of the House Science and Technology Committee and Congresswoman Anna Eshoo of the Energy and Commerce Committee. We deeply appreciate the Task Force's support for substantial new investments in science, which are critical to spurring innovation and jobs," said Pelosi.

APS Launches Electrical Grid, Nuclear Verification Studies

By Lauren Schenkman

The American Physical Society will bring scientific expertise and long-term thinking to the challenges of strengthening nuclear verification and upgrading America's electricity grid with the future release of two reports covering the critical issues. Authored by top physicists with decades of relevant experience, the reports will clarify the science and technology matters associated with the topics.

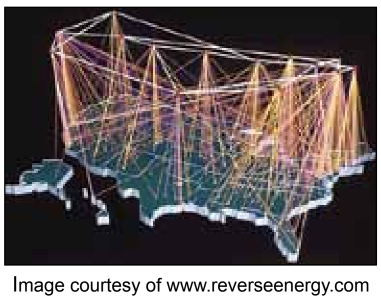


Image courtesy of www.reverseenergy.com

Smart Grid

President Obama vowed in April to reduce and, eventually, eliminate nuclear weapons; since then, his Administration has re-engaged America with nonproliferation by outlining a replacement for the Strategic Arms Reduction Treaty and planning a key summit on the Nuclear Nonproliferation Treaty next year. Jay Davis, the chair of APS's nuclear verification study, said that as the world reduces its stockpile, the challenges of verifying nuclear weapons actually increase.

"As you go further down to lower and lower numbers, inspection regimes are more intrusive and more extensive out of necessity," he said. "To go to zero, you have to…put all the production and disposal [of nuclear fuel] under international control, and that

STUDIES continued on page 3

On the Back Page

US Rep. Bart Gordon discusses the path toward our energy future.

Physicists Bring Their Moxie to National Intelligence

By Calla Cofield

"How many people have heard of DARPA (Defense Advanced Research Projects Agency)?" asks a woman clad in a fuchsia business jacket during a recent APS meeting in Denver. Based on a show of hands, nearly everyone in the conference room knows something about the agency.

She smiles, "OK – we're like DARPA for spies."

That's how Lisa Porter describes the Intelligence Advanced Research Projects Activity (IARPA) – a government agency that began in 2008 and invests in high-risk, high-payoff research to advance national intelligence. Ten years ago, Porter worked as an applied physicist, but 9/11 prompted her to put her efforts toward national security. She is now director of IARPA, where she keeps her physics roots strong.

Porter said the physics community could contribute to national intelligence through a variety of ways: advancing technology from basic research, quantum information science, sensor technology and pushing the size, weight and power limit on increasingly discrete devices.

During a press conference at the Pittsburgh meeting, scientists from Los Alamos National Laboratory and the National Institute for Standards and Technology (NIST) discussed the microcalorimeter, a new device about the size of a quarter, intended for astronomical applications but with potential uses in detecting radioactive materials. Cooled to just above absolute zero – the coldest temperature theoretically possible – the lack of thermal noise gives the microcalorimeters the highest resolution of alpha particles of any detector available.

Current detector technologies cannot discern between radon and uranium, two similar elements, leading to false alarms at border checkpoints. Radioactive radon is usually legal to transport, but uranium sends up a red flag because of its weapons applications. The microcalorimeter could distinguish between the two elements with no ambiguity. Because it could still be three to five years before the device is available for such applications and because it needs to be cooled with liquid helium, a hand-held version is unlikely.

In addition to technology, physicists have expert information that could benefit national security.

For instance, physicist Richard Muller wrote the book, *Physics for Future Presidents: The Sci-*

MOXIE continued on page 3

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 47,000 members.

APS Members in the Media

The Chicago Tribune

"I'm very happy to see popular culture introducing these scientific issues."

***Boris Kayser,* (IL-14th)** *Fermilab, on why he thought the presence of CERN in "Angels and Demons" would be a good marketing tool for science,* Chicago Tribune*, May 20, 2009.*

The Wall Street Journal

"If energy is dirt cheap, it gets treated like dirt."

***Arthur Rosenfeld,* (CA-9th)** *Lawrence Berkeley National Lab, describing why Americans haven't integrated energy-saving appliances into their lives,* The Wall Street Journal*, May 29, 2009.*

USA Today

"There's so much neat science in NASCAR…It's a great way to educate people. NASCAR fans are fervent and will wade through net force and molecules if it helps them understand why something happens to their driver."

***Diandra Leslie-Pelecky,* (TX-32nd)** *University of Texas at Dallas,* USA Today*, July 1, 2009.*

The New York Times

"We put together the best physicists, the best engineers, the best of industry and academia. It's not often you get that opportunity and pull it off."

***Ed Moses,* (CA-10th)** *Lawrence Livermore National Lab, on the team at the National Ignition Facility,* The New York Times*, May 25, 2009.*

The New York Times Magazine

"I no longer own a car. Let me just say that in most of my jobs, I mostly rode my bicycle. [Now], my security detail [doesn't] want me to be riding my bicycle or even taking the Metro. I have a security detail that drives me."

***Steven Chu,* (CA-9th)** *U.S. Department of Energy,* The New York Times Magazine*, April 16, 2009.*

Newsweek

"The fun in 'Star Trek' didn't come from copying science, but from having science copy it. My job wasn't to put real science into 'Star Trek,' but to imagine new ideas that hadn't yet been thought of."

***Leonard Mlodinow,* (CA-29th)** *describing how as a writer for the Star Trek franchise he is able to both incorporate and inspire real science,* Newsweek*, May 4, 2009.*

United Press International

"If we want scientific literacy, then we want teachers to teach the beauty of science, the fun in it, the humor in it, and to bring examples of modern science into the classroom."

***Leon Lederman,* (IL-14th)** *Fermilab,* UPI*, April 10, 2009.*

USA Today

"It turns out a lot of people in Hollywood think science is cool."

Jennifer Ouellette, *(District of Columbia) National Academy of Sciences,* USA Today*, March 25, 2009.*

Snapshots from Physics History

October 22, 2004: Discovery of Graphene

Scientists often find ingenious ways to attain their research objectives, even if that objective is a truly two-dimensional material that many physicists felt could not be grown. In 2003, one ingenious physicist took a block of graphite, some Scotch tape and a lot of patience and persistence and produced a magnificent new wonder material that is a million times thinner than paper, stronger than diamond, more conductive than copper. It is called graphene, and it took the physics community by storm when the first paper appeared the following year.

The man who first discovered graphene, along with his colleague, Kostya Novoselov, is Andre Geim. Geim studied at the Moscow Physical-Technical University and earned his PhD from the Institute of Solid State Physics in Chernogolovka, Russia. He spent two years at the Institute for Microelectronics Technology before taking a fellowship at Nottingham University in England. In 1994, he joined the faculty at the University of Nijmegen in the Netherlands, moving back to England's University of Manchester in 2001 to become director of the Centre for Mesoscience and Nanotechnology.

Scanning electron micrograph of a strongly crumpled graphene sheet on a silicon wafer (Foundation of Fundamental Research on Matter, the Netherlands).

Geim has a knack for quirky yet significant research subjects. He made headlines in 1997 when he used a magnetic field to levitate a frog, garnering him an Ig Nobel Prize in 2000. He once co-authored a paper with his favorite hamster, "Detection of earth rotation with a diamagnetically levitating gyroscope," insisting that "H. A. M. S. ter Tisha" contributed to the levitation experiment "most directly." (According to Wikipedia, the hamster later applied for a PhD at the University of Nijmegen.) And in 2007, his laboratory developed a microfabricated adhesive mimicking a gecko lizard's sticky footpads.

Geim has said that his predominant research strategy is to use whatever research facilities are available to him and try to do something new with the equipment at hand. He calls this his "Lego doctrine": "You have all these difference pieces and you have to build something based strictly on the pieces you've got." In the case of graphene, his lab was well-equipped for the study of small samples.

Carbon nanotubes were – and are – a major area of materials research, and Geim thought it might be possible to do something similar to carbon nanotubes, only in an unfolded configuration. He had the idea to polish down a graphite block to just 10 or 100 layers thick and then study the material's properties. One of his students was assigned the task and produced a speck of graphite roughly 1,000 layers thick – a little short of the mark.

That is when Geim had the idea to use Scotch tape to peel away the top layer. Flakes of graphite come off onto the tape, and the process can be repeated several times to achieve progressively thinner flakes attached to the tape. He then dissolved the tape in solution, leaving him with ultra-thin flakes of graphite: just 10 layers thick. Within weeks, his team had begun fabricating rudimentary transistors with the material. Subsequent refinements of the technique finally yielded the first graphene sheets. "We fooled nature by first making a three-dimensional material, which is graphite, and then pulling an individual layer out of it," said Geim.

In October 2004, Geim published a paper announcing the achievement of graphene sheets in *Science* magazine, titled "Electric field effect in atomically thin carbon films." It is now one of the most highly cited papers in materials physics, and by 2005, researchers had succeeded in isolating graphene sheets. Graphene is a mere one atom thick – perhaps the thinnest material in the universe – and forms a high-quality crystal lattice, with no vacancies or dislocations in the structure. This structure gives it intriguing properties. It also yielded surprising new physics.

From a fundamental standpoint, graphene's most exciting capability is the fact that its conducting electrons arrange themselves into quasi-particles that behave more like neutrinos or electrons moving close to the speed of light, mimicking relativistic laws of physics. In most materials, charge carriers behave in a more classical fashion. Geim has compared the effect to the Large Hadron Collider, "but on your desktop." This makes it possible to test certain ideas in particle physics and astrophysics conceptually on a smaller tabletop scale, rather than in a multi-million dollar collider.

The most obvious application is using graphene to replace silicon chips, since that technology is fast reaching its fundamental limits (below 10 nanometers). It is also possible to make graphene using epitaxial growth techniques – growing a single layer on top of crystals with a matching substrate – in order to create graphene wafers for electronics applications. So graphene holds promise for use in high-frequency transistors in the terahertz regime and for building miniature printed circuit boards at the nanoscale. There are technical barriers: graphene is metallic, so scientists would need to devise a way to make the material semiconducting. They will also need to develop a technique for producing graphene sheets in large quantities if the material is to find application in large-scale industrial sectors.

For now, graphene is being explored as a filler in plastic to make composite materials, in much the same way that carbon nanotubes are used to bolster the strength of concrete materials. Graphene suspensions can also be used to make optically transparent and conductive films suitable for LCD screens.

Graphene may even have the power to tame Geim's notorious five-year itch: that is how frequently he has tended to change research topics in the past. Yet he has even set aside his promising gecko tape research to focus predominantly on graphene, which he admits is by far the most scientifically significant of his results. "With graphene, each year brings a new result, a new sub-area of research that opens up and sparks a gold rush," Geim told *Science* in 2007. "I want to put many more stakes in the ground before it's covered completely, before all the interesting science is claimed and taken. Then it will be time to move on."

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The APS Headquarters is located at One Physics Ellipse, College Park, MD 20740-3844. Phone: (301) 209-3200.

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STUDIES continued from page 1

has economic and corporate issues associated with it, as well as political and national security issues."

Before retiring in 2002, Davis spent 32 years at Lawrence Livermore National Laboratory as a nuclear physicist. His resume covers two decades of nuclear policy experience, including leadership in arms control inspections and support of United Nations inspections of Iraq in 1991 and 2001. Davis is leading the panel in examining technology and protocol improvements that could make the tension-fraught waters of nuclear verification easier to navigate.

Davis said weapon states are loathe to allow inspections, worried that inspectors will seek to profit from the sensitive information that is inevitably revealed. "The problem is, if I measure with high-resolution detectors radiation from a nuclear weapon, I not only know it's a nuclear weapon, I know about its design," he said.

He added that detectors which provide dependable analysis while protecting the details are very much needed.

"It needs to be smart enough to do what you want to do, but dumb enough that it doesn't compromise information," he said.

Another upcoming APS study tackles the modernization of America's electricity grid. Officials have taken a piecemeal approach toward improving the grid since its birth in the early 20th century; this has occurred while the percentage of U.S. primary energy used as electricity jumped from 10 to 40 percent.

By 2030, the amount of electricity carried by the grid will need to increase by 50 percent in the U.S. and double worldwide. Grid study leader George Crabtree is a physicist with more than two decades of research experience in superconductivity at Argonne National Laboratory, where he directs the Materials Science Division. He has participated in a Department of Energy program that explores the use of superconducting materials in the grid; he also served as a congressional witness for a House Science Committee on hydrogen fuel. According to Crabtree, the grid needs major upgrades to accommodate America's growing energy needs. He added that even if America doesn't transition to more renewable energy sources, the country still needs to upgrade the grid.

"We need to send electricity long distances efficiently and reliably," he said. "It's a challenge; [the grid] is not really built to do that, and it's experiencing trouble responding to the demands we have."

Using renewable sources like wind will demand even more from the grid. The study panel is exploring how storage or coupling with non-renewable but on-demand fuels like natural gas could accommodate the intermittency of wind or solar power.

The panel will also examine "smart grid" technology that incorporates decision-making to make the grid more efficient and reliable. Crabtree said he hopes that the study's technical, far-sighted approach will help policymakers take the right first steps.

"Typically, many people with a vested interest in the grid are not thinking broadly or long term, 20 or 30 years from now," Crabtree said. "We want to take a larger view about what technologies might be developed not only in five years, but also over the next two decades."

Both reports will be produced in a short format by the APS Panel on Public Affairs (POPA), said Francis Slakey, Associate Director of Public Affairs, who initiated the POPA reports as a way to inform Congress on physics-related issues.

"These reports have led directly to new federal programs and changes in government policy," he said, adding that many of them have been carried out in response to a congressional request.

MOXIE continued from page 1

ence Behind the Headlines, which addresses critical topics such as energy, nuclear bombs and global warming using scientific reasoning. For the past 10 years, he has taught a class at Berkeley by the same name. Porter also says physicists can contribute their moxie and their methodologies for solving problems to the national security field.

Courtesy of IARPA

She said IARPA is focused on cyber security because of the nation's increasing dependence on the cyber world and a lack of structure for how to study cyber security.

"As physicists, we like to model things and predict behavior," says Porter. "You don't get that a lot in the [cyber security] community."

Cyber security experts currently have no way to quantitatively evaluate how secure any one system is, or even determine which of two systems is more secure. Porter says she hopes that physicists' ways of thinking, modeling, asking questions, organizing and testing will be the key to building a systematic approach to predicting and overcoming cyber vulnerabilities that loom on the horizon.

"Is there a science of cyber security that we could try to develop?" asks Porter. "It certainly seems worth asking the question. If it turns out we can't do it, then along the way, we probably will have learned quite a bit." For more information about IARPA, go to: http://www.iarpa.gov/.

Science! Working for America

APS, in conjunction with the Task Force on American Innovation, designed a sticker emblazoned with the message, "Science! Working for America," to stress the importance of science funding in the American Recovery and Reinvestment Act to jumpstart the slumping economy. During the recent groundbreaking of Brookhaven National Laboratory's National Synchrotron Light Source II (NSLS), stickers were displayed on the hard hats of dignitaries, including U.S. Sens. Chuck Schumer and Kirsten Gillibrand, both of New York. Scientists will use NSLS II, an advanced electron storage ring, to develop clean energy technologies, among other scientific research. The project is expected to create as many as 1,000 jobs during the next several years.

Photo by Brian Mosley

U.S. Should Resume Leadership of Global Physics Projects

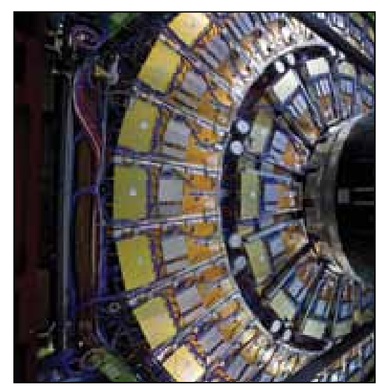
By Nadia Ramlagan

The nation's role as a major player in global science is on the decline, according to a panel of speakers who recently examined the future of international physics projects during an APS meeting in Pittsburgh.

Because each new Congress acts independently, long-term commitment to projects is vulnerable to the annual funding cycle, creating an impression of unreliability in the eyes of other countries, concluded the panelists.

Currently, there are several physics projects at various stages of development that are global in scale, notably the Large Hadron Collider (LHC) – the world's largest and highest energy particle accelerator–and the International Thermonuclear Experimental Reactor (ITER) – a project to design and build an experimental fusion reactor. In addition, SESAME – the development of an international synchrotron light source in the Middle East – is a major regional project.

International collaborations have several benefits: Progress is faster when you draw on the best knowledge no matter its location; sharing project costs leverages resources; and scientists with diverse training and backgrounds tend to generate innovative ideas and solutions.



Courtesy of CERN

Large Hadron Collider (LHC)

As for U.S. involvement in international projects, the country needs to, even in tough economic times, work on resuming its position as the ballast of funding and involvement.

"Any major international project is going to span some period of economic recession. And during that time, it will be very easy to kill an international project; the SSC (Superconducting Super Collider) is one example. Science, especially esoteric science, seems an easy target," said Lawrence Krauss, Director of the Origins Initiative at Arizona State University.

To ensure funding for these projects, showing the public that fundamental research has an economic payoff is imperative. Added Jack Gibbons, Former Assistant to the President for Science and Technology, "We haven't done our homework in going further in pointing out the efficacy of this work to the investors, namely the taxpayers."

Despite the problems that loom ahead, global projects continue to be an inspiration.

"Scientific projects are a model for society; they have been remarkable in allowing countries that will not otherwise interact, to interact, and not just at a peripheral level, but at a fundamental level. The fact that the LHC can be built by thousands of physicists in hundreds of countries speaking dozens of languages, and it actually works–is remarkable," said Krauss.

Kirby Succeeds Franz as APS Executive Officer

Kate Kirby of the Harvard-Smithsonian Center for Astrophysics, is the new Executive Officer of the APS, succeeding Judy Franz, who retired after serving in the position for 15 years. Kirby oversees the day-to-day operations at the APS headquarters in College Park, Md.

She earned her bachelor's degree in chemistry and physics from Harvard/Radcliffe College in 1967 and her PhD from the University of Chicago in 1972. After a postdoctoral fellowship at the Harvard College Observatory (1972-73), she was appointed as Research Physicist at the Smithsonian Astrophysical Observatory and Lecturer in the Harvard University Department of Astronomy (1973-1986 and 2003-2009). She was also a Senior Research Fellow of the Harvard College Observatory. From 1988 to 2001, she served as an Associate Director at the Harvard-Smithsonian Center for Astrophysics, heading the Atomic and Molecular Physics Division. In 2001, she was appointed Director of the National Science Foundation-funded Harvard-Smithsonian Institute for Theoretical Atomic, Molecular and Optical Physics (ITAMP).

Photo by Ken Cole

Judy Franz (left) and Kate Kirby at headquarters of the American Physical Society

Her research interests lie in theoretical atomic and molecular physics, particularly the calculation of atomic and molecular processes important in astrophysics and atmospheric physics. In 1990, she was elected to Fellowship in the APS. Among her other activities: serving on the Department of Energy Basic Energy Sciences Advisory Committee (2003-2008) and as co-chair of the BESAC Subcommittee on Theory and Computation. She has been a member of the National Academy of Sciences/National Research Council Decadal Assessment Committee for Atomic, Molecular and Optical (AMO) Science (AMO2010), and Chair of the International Conference on Photonic, Electronic, and Atomic Collisions (2001-2003).

The Back PAGE

The Path Toward Our Energy Future

By House Science & Technology Committee Chairman Bart Gordon (TN-6th)

The path toward lowering our carbon emissions, meeting our growing need for energy, and growing new sectors of the economy—and the jobs they provide—is through the research and development (R&D) of new energy technologies.

The American Clean Energy and Security Act of 2009 that the House of Representatives approved in July included provisions to help our nation continue on that path. Before this, the Advanced Research Projects Agency for Energy, or ARPA-E, at the Department of Energy (DOE), was authorized in the 2007 America COMPETES Act and finally funded through the Recovery package.

To create the jobs of the future in the U.S., we need to ensure the U.S. leads in developing the transformational technologies that will make it possible for us to meet our growing need for energy without a corresponding increase in greenhouse gas emissions. ARPA-E will bring together the best and the brightest from the private sector, academia, and national labs. ARPA-E has the flexibility to pursue high-risk, high-reward energy technology development at any stage, from basic research to late-stage technology development. The agency is on track to make its first round of awards this month. The first Funding Opportunity Award yielded thousands of applicants – well exceeding expectations. This is clear evidence of a strong, pent-up demand across the U.S. for these sorts of transformational research opportunities.

To create the jobs of the future in the U.S., we need to ensure the U.S. leads in developing the transformational technologies that will make it possible for us to meet our growing need for energy without a corresponding increase in greenhouse gas emissions.

The House version of the American Clean Energy and Security Act will direct 1.05 percent of the carbon allowances to fund ARPA-E; the amount is estimated by the Congressional Budget Office (CBO) to be approximately $650 million by 2012 and will increase thereafter.

However, while I am – and will remain – one of the staunchest advocates for increased investments in R&D, there are problems left to resolve in funding R&D through carbon revenues.

First, there are a few legal barriers to moving funds between federal agencies outside of the Appropriations process. Put simply, the Environmental Protection Agency (EPA) may not be able to pay directly for DOE programs.

While it isn't an optimal scenario, ARPA-E and other externally-focused energy R&D models may provide the possibility of funding grant recipients directly from the revenue from carbon allocations collected by the EPA. By choosing projects with hard start- and end-dates and funding them with cash on hand, we could also avoid the pitfalls of making long-term projects and programs reliant on an unpredictable funding stream. No one knows what the price of carbon will be, let alone the total revenue from carbon allowances. We cannot have effective long-term R&D projects or programs if our scientists are susceptible to potentially inconsistent or boom-bust funding cycles.

Another concern of mine is that, even if we solve these problems and determine viable ways to fund R&D with revenue from selling carbon allowances, there is no guarantee that this will not decrease total funding normally allocated to R&D in the Appropriations process. Appropriators have the unenviable job of making funding decisions when there is always more need than money. We all have been successful in recent years in communicating the importance of investment in science. However, science funding may not always be as high a priority as some of us feel it should be, and DOE research funding has to compete against other important priorities, including protecting Americans from dangerous floods to safeguarding our nuclear stockpile.

ARPA-E has the flexibility to pursue high-risk, high-reward energy technology development at any stage, from basic research to late-stage technology development.

While I have – and will continue, as strongly and as often as I can – to make the case for increases in science and R&D funding as the path to reinvigorating our economy, putting Americans to work, meeting our growing energy needs, and understanding and preventing climate change, the fact remains that, with the recession and the deficit, our national budget is likely to be very tight for the foreseeable future. If our science agencies receive funding from carbon revenue, that funding may be taken into account during the Appropriation process. We have to approach this knowing there is a real risk that the additional funding could put in jeopardy the relatively steady, predictable stream of funding we have worked so hard to ensure.

Our nation needs long-term, comprehensive R&D programs, with strategic roadmaps, and a balanced portfolio of near-term, mid-term, and long-term goals, and robust funding. For that, our agencies need predictable budgets and reliable funding.

While I'm encouraged by the progress that has already been made, there is still a lot of work to be done to determine the best mechanism to fund R&D through a climate bill. I look forward to seeing the Senate's action on the bill, and to working through conference.

We will only be able to reduce our carbon emissions and meet our growing demands for energy through the development and adoption of new technologies. Using the revenue from the caps on carbon to fund R&D is absolutely appropriate; however, we have to figure out appropriate mechanisms for utilizing the funds. I want to make sure we are funding R&D in a sustainable manner. Our nation needs long-term, comprehensive R&D programs, with strategic roadmaps, and a balanced portfolio of near-term, mid-term, and long-term goals, and robust funding. For that, our agencies need predictable budgets and reliable funding.

Congressman Gordon serves as the Chairman of the House Science and Technology Committee and is also a senior member of House Energy and Commerce Committee.