The case for cap-and-trade

MIT analysis shows how plans can cut greenhouse emissions

Researchers at MIT’s Center for Energy and Environmental Policy Research have produced a report concerning key design issues of proposed “cap-and-trade” programs that are under consideration in the United States as a way of curbing greenhouse gas emissions. The first contribution of the three-part study found that, based on an examination of the European Union’s system and of similar U.S. programs for other emissions, such a program can indeed be effective in reducing emissions without having a significant economic impact.

“The European experience confirms much of what has been learned from similar U.S. systems for other emissions, namely, that cap-and-trade systems can be constructed, that markets emerge to facilitate trading, that emissions are reduced efficiently, and that the effects on affected industries are less than predicted,” said A. Denny Ellerman, the study’s lead author and a senior lecturer in the MIT Sloan School of Management.

The study found that the most controversial aspect of the European program was how to allocate the permitted emissions levels to different producers. Initial free allocation of allowances, they found, was the necessary price for gaining political acceptance, as it has been in U.S. systems. Over time, the clearly established trend in the U.E. is to phase out the free allocation, instead relying on a market-based approach.

The second part of the report looked at the impacts of various allocation methods. Researchers examined the possibility of reducing the costs of implementation and reducing the efficiency of the systems. The study concluded that auctions could be a preferable method for allocating allowances, rather than a system that assigns them for free.

The last part of the report included a discussion of potential modifications to the cap-and-trade system, such as the inclusion of a carbon leakage clause to protect industries that might be negatively affected by the program. The researchers concluded that the cap-and-trade system could be effective in reducing greenhouse gas emissions while minimizing economic costs and impacts on affected industries.

Equipping cells with tiny ‘backpacks’

Polymer patches could ferry drugs, assist in cancer diagnosis

Anne Tsui
News Office

MIT engineers have outfitted cells with tiny “backpacks” that could allow them to deliver chemotherapy agents, diagnose tumors or become building blocks for tissue engineering.

“The idea is that we use cells as vectors to carry materials to tumors, infection sites or other tissue sites,” said Darrell Irvine, an author of the paper and associate professor of materials science and engineering.

The researchers worked with B and T cells, two types of immune cells that can home to various tissues in the body, including tumors, infection sites, and lymphoid tissues — a trait that could be exploited to achieve targeted drug or vaccine delivery.

“The goal is to perturb the cell as little as possible,” said Robert Cohen, the St. Laurent Professor of Chemical Engineering at MIT and an author of the paper.

The polymer backpacks allow researchers to use cells to ferry tiny cargoes and manipulate their movements using magnetic fields. Since each patch covers only a small portion of the cell surface, it does not interfere with the cells’ normal functions or prevent it from interacting with the external environment.

Another possible application is in tissue engineering. Patches could be designed that allow researchers to align cells in a certain pattern, eliminating the need for a tissue scaffold. The polymer patch system consists of three layers, each with a different function, stacked onto a surface. The bottom layer tethers the polymer to the surface, the middle layer contains the agents that carry the therapeutic payload, and the top layer is designed to be biocompatible and support cell adhesion.

MIT researchers have developed a technique to attach tiny “backpacks” to cells.

Singing in slow motion

MIT researchers study of songbirds could help to understand humans’ timing.

Anne Tsui
News Office

Renowned economists, including MIT’s Robert Solow, give advice to President-elect Barack Obama.

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People

Young scientists honored

Ed Boyden and Sara Seager are named to Discover magazine’s “Top 20 Under 40” list.

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Research

Singing in slow motion

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News

What should Obama do?

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MIT football coach Dwight Smith retires

Football Conference. In 2007, Smith received the Ron Burton Distinguished American Award for Lifetime Achievement sponsored by the Jack Grimoldi Endowment of the Massachusetts Chapter of the National Football Foundation.

“Seo often in college sports, coaches use their current job as a stepping stone to the next job,” noted Julie Sortoriz, director of athletics and head of DAPER. “In Dwight’s case, the long history of his career at MIT speaks to his commitment to his team and this institution; it is admirable. To wrap up this season with a number of unprecedented accomplishments and career records is a fitting way to conclude his historic career.”

Smith, who will remain at MIT as a full-time professor in physical education, enjoyed a tremendous season in 2008 as the Engineers shattered a bevy of team records. MIT set single-season records in total points, total yards, points scored, and first downs while junior DeRon Brown closed out the season as the NCAA Division III leading rusher.

Events at MIT

Two scientists named to Discover’s ‘Top 20 Under 40’ list

Chomsny also cited for lifetime achievement

Discover magazine has named two MIT researchers — Ed Boyden and Sara Seager — among its top 20 scientists under 40.

Boyden, the Benesse Career Development Professor, assistant professor in the MIT Media Lab and professor in the Department of Biological Engineering and Department of Brain and Cognitive Sciences, is currently working on designing technologies for controlling the processing in specific neural circuit targets in the brain. Boyden, 29, is also an alumnus of MIT, receiving his MEng and dual SBs in 1999.

Discover cited Boyden for his work on “engineering brain implants that can stimulate ... with light pulses,” which he hopes could help treat brain diseases including Parkinson’s.

“There are things that light can do that purely electric stimulators can’t,” Boyden noted in the magazine.

Seager, 36, the Ellen Swallow Richards Associate Professor of Planetary Science and an associate professor of physics, was cited for her work on the study of exo-planets and models that have “helped researchers make the first atmospheric measurements of a distant world.”

“Who really wanted to try to figure out what kinds of gases extraterrestrial life might produce,” Seager told Discover however. “These gases would accumulate in the atmosphere and might be detectable from afar.”

Seager, who joined MIT in 2007, was also part of a team that co-discovered the first known light emitted from an exoplanet and the first spectrum of an exoplanet.

The “Top 20 Under 40” list appears in the magazine’s December issue. Institute Professor emeritus Nono Chomsny was also cited in the same issue as a lifetime achiever who “has redefined our understanding of ourselves as humans.”

Gordon L. Brownell, professor emeritus, 86

Nuclear Science and Engineering Professor Emeritus Gordon L. Brownell PhD ’50, a widely respected physicist and inventor, died at his home Tuesday, Nov. 11, following a long illness. He was 86.

Brownell’s research involved in developing positron imaging and positron emission tomography. In the 1950s, together with nuclear engineer George W. Swets of Massachusetts General Hospital, he pioneered the use of the technology to detect and locate brain tumors in human patients. In addition, Brownell developed boron neutron capture therapy for treatment of brain tumors.

Born in Dunkin, Okla., and raised in New York and Pennsylvania, Brownell received his BS from Bucknell University and his PhD in physics from MIT. During World War II, he served in the Navy Research Group to develop devices to detect the atoms deep-sea mines.

Brownell established the Physics Research Laboratory at MIT in 1951 and served as the honorary physicist in the Department of Radiology at MGH until his death. He was named professor at MIT in 1956 and served as a professor emeritus in the Department of Nuclear Science and Engineering at MIT until his death.

In 2002, Brownell’s contributions to science were rewarded with election to the Institute of Medicine. More details on his achievements in imaging instrumentation can be found at www.mit.edu/~gb2/.

Though Brownell’s life was largely consumed with scientific research, he was an avid world traveler and reader. In his later years, he involved in real estate development in St. John, U.S. Virgin Islands. In addition to his wife, Miriam (Prum) Brownell, he is survived by six children: Wendy L. Silverman of Needham, Peter G. Brownell of Marlborough; David L. Brownell of Medford, James K. Brownell of Wellesham, Pia J. DiMeco of Wilmington, and Janne K. Kairento of Beverly. He is also survived by a brother, Roscoe Brownell Jr., of Altoona, Pa., and seven grandchildren.

A funeral was held Saturday, Nov. 15, in the First Church in Salem. In lieu of flowers, memorial contributions may be made to The Gordon L. Brownell Scholarship Fund for the Advancement of Physics, c/o Salem Five Bank Account. #771048947, 210 Essex St., Salem, MA 01970.

For guest book and additional information please visit www.levesqfunerals.com.

Margaret Zarudny Freeman, directed MIT’s “language lab” — one of the first of its kind. She later had hoped to continue her education, the arrival of her four younger sisters in Boston led her to find work instead as a designer of steam turbines for General Electric.

In 1951, she married Harold Freeman, a fellow graduate student who went on to become a distinguished statistician in the MIT Department of Economics. In 1958, Freeman returned to MIT, working as an applied mathematician in the renowned Wiener-Rosenblith electroncephalography project.

In the 1960s, with the growing interest in the Soviet Union, Freeman introduced Russian language instruction to MIT by volunteering to teach the language. She later led MIT’s “language lab”, — one of the first kind.

After her retirement in 1978, Freeman was named an associate professor emeritus.

Freeman leaves behind her sons, Arthur Freeman of London and Edward Freeman of Los Angeles; two sisters, Kateria Singleton of Providence and Zoya Chambers of London and Edward Freeman of Los Angeles; two sisters, Kateria Singleton of Providence and Zoya Chambers of London and Edward Freeman of Los Angeles; two sisters, Kateria Singleton of Providence and Zoya Chambers of London and Edward Freeman of Los Angeles; two sisters, Kateria Singleton of Providence and Zoya Chambers of London and Edward Freeman of Los Angeles; two sisters, Kateria Singleton of Providence and Zoya Chambers of London and Edward Freeman of Los Angeles; two sisters, Kateria Singleton of Providence and Zoya Chambers of London and Edward Freeman of Los Angeles; two sisters, Kateria Singleton of Providence and Zoya Chambers of London and Edward Freeman of Los Angeles; two sisters, Kateria Singleton of Providence and Zoya Chambers of London and Edward Freeman of Los Angeles; two sisters, Kateria Singleton of Providence and Zoya Chambers of London and Edward Freeman of Los Angeles; two sisters, Kateria Singleton of Providence and Zoya Chambers of London and Edward Freeman of Los Angeles; two sisters, Kateria Singleton of Providence and Zoya Chambers of London and Edward Freeman of Los Angeles; two sisters, Kateria Singleton of Providence and Zoya Chambers of London and Edward Freeman of Los Angeles; two sisters, Kateria Singleton of Providence and Zoya Chambers of London and Edward Freeman of Los Angeles; two sisters, Kateria Singleton of Providence and Zoya Chambers of London and Edward Freeman of Los Angeles; two sisters, Kateria Singleton of Providence and Zoya Chambers.
De Neuville wins Fulbright award; seven others coming to MIT
Richard L. de Neuville, a professor in the Engineering Systems Division and the Department of Civil and Environmental Engineering, is a Fulbright Scholar. De Neuville is one of approximately 1,000 faculty and staff members worldwide from the United States to be given the award, which allows them to lecture and conduct research abroad.

In addition, seven foreign faculty and staff have been awarded Fulbright scholar awards to come to MIT. They are Patricia Almeida de Carvalho, an assistant professor from the Technical University of Lisbon; Luísa Iandoli, an associate professor from the University of Naples Federico II; Yasser Revez Omar, an assistant professor from the Technical University of Lisbon; Carmel Almeida de Carvalho, an assistant professor from the Technical University of Lisbon; and Doris Dobi, a senior, will receive an award; seven others will receive Fulbright awards to come to MIT. They are Patricia Almeida de Carvalho, an assistant professor from the Technical University of Lisbon; Luísa Iandoli, an associate professor from the University of Naples Federico II; Yasser Revez Omar, an assistant professor from the Technical University of Lisbon; Carmel Almeida de Carvalho, an assistant professor from the Technical University of Lisbon; and Doris Dobi, a senior, will receive an award; seven others will receive Fulbright awards to come to MIT.

MIT researchers receive American Heart Association grants
The American Heart Association announced that it has awarded new grants to four MIT researchers, with each of their awards effective July 1, 2008. The four recipients are Jorien Su, an assistant professor in the Department of Biology; Cheng-Tin Lin, a graduate student in the Department of Mechanical Engineering (MechE); Chen-rei Wan, a graduate student in MechE; and Eric Weiss, a graduate student in the Harvard-MIT Division of Health and Safety.

IS&T wins computing services newsletter award
Robyn Fizz and Lee Ridgway, of MIT Information Services and Technology, were recently honored by the ACM Special Interest Group for University and College Computing Services (ACM SIGUCCS) for their published newsletter, which is the best in North America by EDUNIVERSAL, a one-of-a-kind, got-to-be-seen-to-be-believed engineering feat.

MIT Sloan garners international award
The MIT Sloan School of Management was named third-best business school in North America by EDUNIVERSAL, which ranked the top three schools in nine different geographical regions.

MIT EHS Office recognized by City of Cambridge
At the fall annual awards and recognition dinner for the Cambridge Fire Department, the MIT Environment, Safety and Health (EHS) Office, along with the Harvard Department of EHS, were recognized with a Certificate of Appreciation. CFD Deputy Chief Gerald Mahoney, while presenting the certificates, noted that his department has “a relationship with both schools’ EHS staffs that allows us to call upon them not just for incidents on their respective campuses, but also to utilize their subject matter expertise at any time for any incident, 24 hours a day, seven days a week.”

Events at MIT
Thursday, Nov. 20
• Kick-Butt Great American Smokeout Contest. 12:15 p.m. in E53-Armrum. To mark this year’s Great American Smokeout, MIT Medical is sponsoring a “Kick-Butt” contest. The participating teams have each built a deliberately over-engineered mechanical apparatus that will perform the simple task of extinguishing a cigarette in an extremely indirect and convoluted fashion.

• Judicial Discretion Under the Federal Sentencing Guidelines: The Impact of Changes in the Standard of Review. Speaker: Joshua Fischman (Virginia School of Law). 4:30-6 p.m. in E53-482.

Friday, Nov. 21
• Futures of Entertainment 3. All day Friday and Saturday in E51. Convergence culture has moved swiftly from buzzword to industry logic. The creation of transmedia storyworlds, understanding how to appeal to auditory audiences, and the production of digital extensions for traditional materials are becoming the broad and emerging corner of work in the media. Futures of Entertainment 3 once again brings together key industry influencers who are shaping these new directions in our culture and academic scholars immersed in the investigation of the social, cultural, political, economic, and technological implications of the changes in our media landscape.

Monday, Nov. 24
• STS Colloquium: “Technological Leadership and American Hegemony.” Speaker: John Krige, Georgia Inst. of Technology. 4-6 p.m. in E53-150. This talk will describe how the United States used its technological advantage in two key strategic domains, nuclear power and space, in an attempt to reconstruct postwar Europe.

Friday, Nov. 28
• Friday After Thanksgiving: Chain Reaction. 1-4 p.m. in W33, Rockwell Cage Gymnasium, 120 Vassar St. Whether it’s reacting to the induction between one creative contraption and another equally crafty contraption, or the primal reaction of the blood and the faces of the spectators, the MIT Museum’s Friday After Thanksgiving (Thanksgiving Chain Reaction) is a one-of-a-kind, got-to-be-seen-to-be-believed engineering feat.

Tuesday, Dec. 2
• 2008 MIT Robotics Conference. 8 a.m.-5 p.m. in E51-Wong Auditorium.
Early warning of dangerous asteroids and comets

Dorothy Ryan
MIT Lincoln Laboratory Communications Office

Silicon chips developed at MIT Lincoln Laboratory are at the heart of a new survey telescope that will soon provide a more than fivefold improvement in scientists’ ability to detect asteroids and comets that could someday pose a threat to the planet.

The prototype telescope installed on Haleakala mountain, Maui, will begin operation this December. It will feature the world’s largest and most advanced digital camera, using the Lincoln Laboratory silicon chip. This telescope is the first of four that will be housed together in one dome. The program, called Pan-STARRS (for Panoramic Survey Telescope and Rapid Response System), is being developed at the University of Hawaii’s Institute for Astronomy.

“Pan-STARRS is a very, very giant instrument,” said University of Hawaii astronomer John Tonry, who led the team developing the new 1.4-gigapixel camera. “We get an image that is 18,000 by 18,000 pixels in size, or about 200 times larger than you get in a high-end consumer digital camera.”

Pan-STARRS, whose cameras cover an area of sky six times the width of the full moon and can detect stars 10 million times fainter than those visible to the naked eye, is also unique in its ability to find moving celestial objects. Lincoln Laboratory’s charge-coupled device (CCD) technology is a key enabling technology for the telescope’s camera. In the mid-1990s, Lincoln Laboratory researchers Barry Burke and Dick Sayers of the Advanced Imaging Technology Group, in collaboration with Tonry, who was then working at MIT, developed the technology for an orthogonal-transfer charge-coupled device (OTCCD), a CCD that can shift its pixels to cancel the effects of random image motion. Many consumer digital cameras use a moving lens or chip mount to provide camera-motion compensation and thus reduce blur, but the OTCCD does this electronically at the pixel level and at much higher speeds.

The challenge presented by the Pan-STARRS camera is its exceptionally wide field of view. For wide fields of view, jitter in the stars begins to vary across the image, and an OTCCD with its single spatial shift pattern for all the pixels begins to lose its effectiveness. The solution for Pan-STARRS, proposed by Tonry and developed in collaboration with Lincoln Laboratory, was to make an array of 60 small, separate OTCCDs on a single silicon chip. This architecture enabled independent shifts optimized for tracking the varying image motion across a wide scene.

“It not only was Lincoln the only place where the OTCCD had been demonstrated, but the added features that Pan-STARRS needed made the design much more complicated,” said Burke, who was working on the Pan-STARRS project.

“It is fair to say that Lincoln was, and is, uniquely equipped in chip design, wafer processing, packaging, and testing to develop such technology.”

The primary mission of Pan-STARRS is to detect near-Earth objects, or asteroids and comets that could be dangerous to the planet. When the system becomes fully operational, the entire sky visible from Hawaii (about three-quarters of the total sky) will be photographed at least once a week, and all images will be entered into powerful computers at the Maui High Performance Computer Center. Scientists at the center will analyze the images for changes that could reveal a previously unknown asteroid. They will also compile data from several images to calculate the orbits of asteroids, looking for indications that they may be on a collision course with Earth.

Pan-STARRS will also be used to catalog 99 percent of stars in the northern hemisphere that have ever been observed by visible light, including stars from nearby galaxies. In addition, the Pan-STARRS survey of the whole sky will provide the opportunity to discover, and monitor, planets around other stars, as well as rare explosive objects in other galaxies.

Detailed information about the Pan-STARRS design and its science applications can be found at [http://pan-starrs.ifa.hawaii.edu/public/]. The project was funded by the U.S. Air Force Research Laboratory.
Untangling DNA regulation

Biologists theorize role for DNA packaging in stem cell development

Anne Trafton
News Office

MIT biologists have discovered that the organization of DNA's packaging material plays a critical role in directing stem cells to become different types of adult cells.

The work, published in the journal Cell on Nov. 14, could shed light on the possible role of DNA packaging in cancer development.

Led by Laurie Boyer, assistant professor of biology at MIT, the researchers examined the role of chromatin — the structure that forms when DNA is wound around a core of proteins called histones.

“We’re particularly interested in how chromatin structure influences gene expression and ultimately cell fate,” Boyer said. “We hope the studies we are doing can lead to better understanding of development as well as certain diseases.”

It has been theorized that cancer cells may overwrite genes involved in early embryonic development, allowing them to proliferate unchecked and regress from adult tissue cells to a stem-like state.

Such regression could be partly mediated by changes in chromatin. This packaging is believed to help control DNA transcription because the more tightly wound the chromatin is, the less accessible DNA is to be transcribed.

The new study focused on a variant type of histone known as H2AZ, which other researchers have recently identified as a protein of interest in cancer.

While H2AZ is ubiquitously expressed in many cell types including adult cells, it is essential for normal embryonic development. The new research reveals why: The variant histones are found near the promoters of a particular set of genes important for development.

The same genes are also regulated by a group of proteins known as Polycomb group (PCG) proteins, which act as gene silencers.

“It suggests that this histone variant — along with the Polycomb group proteins — may act as some kind of regulatory switch that mediates cell fate transitions,” Boyer said. “We hypothesize that they’re working together, and that allows these genes to be silent yet poised for activation in stem cells.”

In future studies, Boyer’s team plans to look at patterns of H2AZ distribution in cancerous cells.

Lead authors of the paper are Whitehead Institute postdoctoral associates Menno Creyghton and Styliani Markoulaki. Other authors are Whitehead postdoctoral associates Stuart Levine and Jacob Hanna; graduate student Michael Ledato; Ky Sha, a postdoctoral associate in biology; Richard Young, professor of biology; and Rudolf Jaenisch, professor of biology and member of the Whitehead Institute.

The research was funded by the Dutch Cancer Foundation, the Helen Hay Whitney Foundation, the National Institutes of Health and Genzyme Corp.

Media Lab creates Center for Future Storytelling

Teams up with Plymouth Rock Studios to reinvent the movies

The MIT Media Laboratory announced Tuesday the creation of the Center for Future Storytelling, made possible through a seven-year, $25 million commitment from Plymouth Rock Studio, a major motion picture and television studio that is expected to open in 2010 in Plymout, Mass.

With the establishment of the center, whose research program begins immediately, the Media Lab and Plymouth Rock Studios will collaborate to revolutionize how we tell our stories, from major motion pictures to peer-to-peer multimedia sharing.

By applying leading-edge technologies to make stories more interactive, improvisational and social, researchers will seek to transform audiences into active participants in the storytelling process, bridging the real and virtual worlds, and allowing everyone to make their own unique stories with user-generated content on the Web.

Research will also focus on ways to revolutionize imaging and display technologies, including developing next-generation cameras and programmable studios, making movie production more versatile and economic.

“Storytelling is at the very root of what makes us uniquely human,” said Frank Moss, Media Lab director and holder of the Jerome Wiesner Professorship of Media Arts and Sciences. “It is how we share our experiences, learn from our past, and imagine our future. But how we tell our stories depends on another uniquely human characteristic: Our ability to invent and harness technology. From the printing press to the Internet, technology has given people new ways to tell their stories, allowing them to reach new levels of creativity and personal fulfillment. The shared vision of the MIT Media Lab and Plymouth Rock Studios allows us to take the next quantum leap in storytelling, empowering ordinary people to connect in extraordinary ways.”

“It is a great opportunity to draw on the exceptional intelligence and innovation for which the Media Lab is known worldwide,” said David Kirkpatrick, chairman and executive managing partner of Plymouth Rock Studios and former president of Paramount’s Motion Picture Group. Plymouth Rock Studios was conceived as a source for innovation and as a proving ground for new storytelling technologies. This collaboration will transform the movie-making model, and erase some of the technology barriers that constrain the narrative form.”

The Center for Future Storytelling will be co-directed by three Media Lab principal investigators: V. Michael Bove Jr., an expert in object-based media and interactive television; LG (Lentor) Associate Professor Cynthia Breazeal, a leader in the field of personal robots and human-robot interaction; and Associate Professor Ramesh Raskar, a pioneer in the development of new imaging, display and performance-capture technologies.

Research will range from on-set motion capture to accurately and unobtrusively merge human performers and digital character models; to next-generation synthetic performer technologies, such as richly interactive, highly expressive robotic or animated characters; to cameras that will capture entire scenes in a single take; to ingestible movie studios, where one studio can be turned into many through advanced visual imaging techniques; to b holographic TV. It will draw on technologies pioneered at the Media Lab, such as digital systems that understand people at an emotional level, or cameras capable of capturing the intent of the storyteller.

“We see this as an experiment in collaborative education, but also as a bold adventure in business innovation that could have significance well beyond the motion picture industry,” Moss said.

From left to right, David Kirkpatrick, chairman of Plymouth Rock Studios, Cynthia Breazeal, co-director of Media Lab’s Center for Future Storytelling, and Frank Moss, director of the MIT Media Lab, stand with Neri, a mobile, dexterous social robot developed by Breazeal’s Personal Robots research group.

Under the (robotic) knife

Engineering students design robots to remove tumors

Anne Trafton
News Office

MIT students will take to the operating table next Monday, Nov. 24, to show off their robotic engineering skills in the final presentations for Course 2.12 (Introduction to Robotics).

Four teams of students have spent the past seven weeks building robotic arms and writing software that will allow them to remotely make an incision in a silicone “organ” and remove a jelly bean masquerading as a tumor.

Surgery is a rapidly growing sector of robotics business, says Professor of Mechanical Engineering Harry Asada, who teaches the course.

“Augmenting a surgeon’s skills and expertise with superb precision and dexterity of robotic devices, we can expect highly reliable, minimally invasive surgical operations,” he says. “However, there are many technical challenges to make the system truly useful.”

The course emphasis is on learning to design a robot that can perform a specific task and operate within a confined space, says Harrin Chun, laboratory instructor for the course.

Past years’ course assignments include building search and rescue robots, and building robots for automated inspection of Big Dig tunnels.

“We try to motivate it with a real world problem,” says Lau Odhner, one of the laboratory TAs for the class and a graduate student in mechanical engineering.
People had predicted that coal would never rise above a price of $10 a ton, but it is now $200 or more. As a result, he said, largely because high prices have led to an influx of new alternative sources. And there is a similar disparity between demand and new sources of supply for coal, he said.

For example, an armada of new liquefied natural gas tankers is about to come into service, bringing to market a huge quantity of gas for which “the demand doesn’t exist,” he said. Falling oil prices and the uncertainties of these long lead times. How can anyone predict “what the economy is going to require in five years?”

As a result, he said, “we could see a hiatus in investing in new supplies.”

Right now there are major new sources of supply about to come online in oil, natural gas and coal, just at a time when demand is falling, along with prices, because of the troubled economic situation.

Differences in the abatement costs associated with long-term, short-term and start-up costs.

The report’s third section examined the relationship between state and federal regulations on greenhouse gas emissions. With no federal policy now in place, many states are moving forward with their own initiatives, which range from commitments to reduce greenhouse gases to a regional, multistate cap-and-trade program slated to begin in 2009.

While federal legislation is expected in the next few years, it is unclear how it will define the relationship between a federal cap-and-trade program and other state or regional initiatives. The report analyzes the economic and environmental impacts of the range of possible interactions between the federal program and state or regional programs.

Differences in the abatement costs among states can create economic inefficiencies that make achievement of the climate goals more costly than it need be. This inefficiency can be avoided by either federal preemption of duplicative state programs, the authors found, or by a “curve out” of more demanding state programs from the federal cap with linkage.

In addition to Ellerman, the research was co-authored by Mort D. Webster, assistant professor of engineering systems in the Engineering Systems Division; John Parsons, senior lecturer in science, Technology and Policy; and Connie Cheng, a recent Harvard graduate.

The research was funded by the National Science Foundation Materials Research Science and Engineering Center and an NSF Graduate Research Fellowship.

No Tech Talk on Nov. 26

Because of Thanksgiving, there will be no Tech Talk next week. For updated coverage of MIT news, please see our web site at web.mit.edu/newsoffice.

MIT helps launch interactive video education project in Jordan

Two MIT professors traveled to Jordan this month to help kick off a new initiative called Blended Learning Open Source Science or Math Studies (BLOSSOMS), a joint international collaboration of educators from the United States, Jordan and Pakistan.

Richard Larson, director of the Center for Engineering Systems Fundamentals and the Mitsui Professor of Engineering Systems and Civil and Environmental Engineering, and Walter Lewin, professor of physics, traveled to meet counterparts in Jordan — including educators from Jordan University, the Jordan University of Science and Technology and the Jordan Educational Initiative — who will help run the BLOSSOMS program.

BLOSSOMS aims to develop a large, free repository of science and math interactive video modules for high school students created by gifted volunteer teachers from around the world, seeded initially by MIT faculty members and partnering educators in Jordan and Pakistan. The project seeks to develop deeper and richer skills in high school students, to enhance their critical-thinking skills and to motivate them to pursue careers in science, math or engineering.

This is a situation where the financial sector has experienced a shock that has spilled over into the real economy.

John Reed

Retired Citigroup chairman

“If you build it ...”

Earlier this month, MIT student volunteers helped build a home for a family in need in Bedford, Mass. Several of the MIT students took a break from hammering and sawing to explain their role in the project, which can be seen in an audio slideshow available on the News Office web site at web.mit.edu/newsoffice/2008/habitat-1112.html.

CARBON: MIT analysis shows how cap-and-trade plans can cut greenhouse gas emissions

Continued from Page 1

Associated with long-term, short-term and start-up costs.

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Institute Professor emeritus and Nobel Prize winner Robert Solow, right, and Harvard University professor N. Gregory Mankiw PhD ‘84, left, took part in a panel discussion Thursday, Nov. 13, examining economic policies for President-elect Barack Obama. Mankiw Professor of Economics James Poterba, middle, chaired the panel.

Solow, Mankiw see promising future, short-term problems

Patrick Gilloloy
News Office

Two renowned economists agreed Thurs-
day, Nov. 13, that America is facing several major challenges with economic implications — including health care costs, climate change and the credit crunch — but differed on how President-elect Barack Obama should handle those crises efficiently.

Mankiw, the Department of Economics and the Undergraduate Economics Association.

Solow expressed excitement for the new administration (“I voted for Obama and I didn’t hesitate for a second”) while also noting the problems that may lie ahead (“I don’t expect miracles from the Obama administration”). But, he noted, policymaking is about more than one person.

“The two-party system goes against economic miracles,” Solow said.

Despite a freezing of “plain vanilla lending” — commercial and generally safe lending — there is no reason to be completely dooms-andgloom, he said. “The productive capacity of the economy is still there.”

“The first order of business ought to be to do something about funding off the recession,” he added. “Anything that is done along that line will have an impact with three or four times impact policy.”

Solow also credited the steps already made by Federal Reserve Chairman Ben Bernanke PhD ‘79, comparing him to Captain Kirk from Star Trek. “He has loaned where no man has loaned before.”

While taking steps in the short term may pay off now, Solow said it would be unwise to think that results would be immediate.

“What happens now, the federal deficit is going to be close to trillion dollars,” a brief question and answer session following the forum brought forth the question of General Motors and whether the government should bail it out as it did for Wall Street’s financial firms.

“When do you stop? Once you get through the auto industry there will be other industries [asking for money] as well,” Solow said, pointing out a bigger problem that is “not about GM, but about fixing a nonsensical system that fixes health care to employment.”

Mankiw suggested offering money, but only if there was private investment to back it up.

“There’s no point putting public money into a company that no private investor deems viable,” he said.

Economics for Obama

Open enrollment closes on Nov. 21

Don’t forget that any benefits changes for 2009 must be made by the Open Enrollment deadline, which is at 4 p.m. on Nov. 21. All benefits-eligible faculty and staff are eligible to enroll or make changes to their medical and dental coverage, enroll in flexible spending accounts, and review all benefits at MIT until this deadline.


Global Entrepreneurship Week running this week

More than two dozen MIT departments and student organizations are combining efforts to help celebrate Global Entrepreneurship Week, which started on Nov. 17 and runs until Nov. 23.

The week, spearheaded by the Ewing Marion Kauffman Foundation, is the first-ever international celebration of enterprising behavior as a way to engage young people in entrepreneurship — something that already happens quite naturally across the MIT community. With different events that spotlight networking, entrepreneurial success stories, MIT alumni entrepreneurs and more, Global Entrepreneurship Week at MIT will bring together members of MIT’s community to celebrate the unique entrepreneurial energy created by students, faculty, staff and alumni.

For full details and a calendar of events and activities, please go to the Global Entrepreneurship Week at MIT site at http://enterpriseforum.mit.edu/eweek.html.

Legatum Center announces IAP Seed Grants

Are you an aspiring entrepreneur who is interested in the role of the private sector in the developing world? Have an idea for a business that you think can make a difference?

Applications are now being accepted for a seed grant from the Legatum Center for Development and Entrepreneurship at MIT and run these ideas into reality.

MIT undergraduate and graduate students are invited to apply for up to $2,000 in funding to support projects investigating the development of for-profit businesses in low-income countries during the 2008-2009 IAP Session. Grants are distributed through a competitive selection process that takes into account the viability and impact of each project proposal. Seed grant applications must be submitted by 1 p.m. on Nov. 21 for complete seed grant application instructions, and to learn more about the Legatum Center, please visit our website at http://legatum. mit.edu/grant.

Blood drive at MIT through Friday

MIT’s American Red Cross Team and Network is conducting a blood drive this week in the La Sala of Puerto Rico on the second floor of the MIT Student Center.

Remaining dates and times for the blood drive are:

Today — noon to 6 p.m.
Thursday, Nov. 20 — noon to 6 p.m.
Friday, Nov. 21 — noon to 6 p.m.

For more information or to make an appointment, visit http://web.mit.edu/blood-drive/www/.

Faculty meeting today

A regular meeting of the faculty will take place today at 3:30 p.m. in Room 10-250. The agenda includes:

• A proposal to revise the general institute requirements.
• An update on underrepresented minority faculty and graduate student recruitment and retention.
• An update from the Initiative on Faculty Race and Diversity.

FOR SALE


FOR RENT

Watertown: Sunny 8 bedroom two-floor. Newly renovated. 3 full bathrooms, total 10 Rms, new kitchen, off St. parking, hard floor, close to Bus and rail. Hourly housing on Nov. 17 and runs until Nov. 23. Contact feng@psfc.mit.edu. MIT vacation home for rent. Located on Okemo mountain resort. Newly built 300m plus left, 2 full baths great location near kitchen, hardwood floors etc call 617-650-7381. East Boston, 5 Rms, 380f/m, w/d, remodel, Lg Yard and Porch. $ 5 Min walk to T. No Pets please. $1250/monthly. Call 710-657- 3827 or 857-651-4477 Office and R&D Space for Rent. Excellent of- fice-R&D space in West Newton at Ex 16 of Mass. 10 minutes from MIT ample parking, fully furnished and AC. Some office furniture and cubicles available.

MISCELLANEOUS

Want to stay a place to (condo, apt., etc.,) within 30 minutes of Sunday River, ME. Will be used by 2 adults and 2 children, ages 8-10 for week-end ski tramps. e-mail: skitrip@mit.edu to get 603-514-0512.

CLASSIFIED ADS

Members of the MIT community may submit one ad each issue. Ads should be 30 words or less per ad; minimum; they will be edited. Submit by e-mail to trade.mit.edu or mail to Classifieds, Rm 11-400. Deadline is noon Wednesday the week before publication.

For Sale:

• A proposal to revise the general institute requirements;
• An update on underrepresented minority faculty and graduate student recruitment and retention;
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The 9th International Conference on Greenhouse Gas Control Technologies (GHGT-9), organized by MIT in collaboration with the IEA Greenhouse Gas R&D Programme (IEA GHG), with sponsorship from the U.S. Department of Energy, is taking place this week in Washington, D.C. It features several MIT papers on greenhouse gas control and reduction.

A quicker, easier way to make coal cleaner
Nancy Stauffer
MIT Energy Initiative

Construction of new coal-fired power plants in the United States is in danger of coming to a standstill, partly due to the high cost of the requirement — whether existing or anticipated — to capture all emissions of carbon dioxide, an important greenhouse gas. But an MIT analysis suggests an intermediate step that could get construction moving again, allowing the nation to fend off growing electricity shortages using our most-abundant, least-expensive fuel while also reducing emissions.

Instead of capturing all of its CO2 emissions, plants could capture a significant fraction of those emissions with less costly changes in plant design and operation, the MIT analysis shows.

“Our approach — ‘partial capture’ — can get CO2 emissions from coal-burning plants down to emissions levels of natural-gas power plants,” said Ashleigh Hilderbrand, a graduate student in chemical engineering and the Technology and Policy Program. “Policies such as California’s Emissions Performance Standards could be met by coal plants using partial capture rather than having to rely solely on natural gas, which is increasingly imported and subject to high and volatile prices.”

Hilderbrand will present her findings on Nov. 18 at the 9th International Conference on Greenhouse Gas Control Technologies in Washington, D.C. Her co-author is Howard J. Herzog, principal research engineer at the MIT Energy Initiative and chair of the conference organizing committee.

The United States is facing a pressing need for more power plants that run essentially all the time. Renewable sources are currently too expensive and subject to high and volatile prices.

The push for full capture (defined as 90 percent of total plant emissions) is in part economic: Everyone assumed that 90 percent capture would — due to economies of scale — yield the lowest cost per ton of CO2 removed. Anything less than 90 percent would yield a higher per-ton cost. But now MIT engineers have come underground.

According to the 2007 MIT study, “The Future of Coal,” and other sources, capturing CO2 at coal-burning power plants and storing it in deep geological basins will mitigate its negative effects on the atmosphere.

However, injecting too much CO2 could create or enlarge underground faults that may become conduits for CO2 to travel back up to the atmosphere, said Ruben Juanes, assistant professor of civil and environmental engineering (CEE) and one of the authors of the work. “Our model is a simple, effective way to calculate how much CO2 a basin can store safely. It is the first to look at large scales and take into account the effects of flow dynamics on the stored CO2,” he said.

Already Juanes and co-author CEE graduate student Michael L. Szulczewski have applied their model to the Fox Hills Sandstone in the Powder River basin straddling Montana and Wyoming. They found that the formation would hold around 5 gigatons of CO2 — more than half of all the CO2 emitted by the United States each year.

A geological basin is a large underground bowl that can hold tons of CO2. The MIT model predicts how much a plume of CO2 will migrate from its injection well and into the basin, and the path it is likely to take due to underground slopes and groundwater flow.

“Many of the projects being discussed at small scales,” Szulczewski said. “If we’re going to offset emissions, however, we’re going to inject a lot of CO2 into the subsurface. This requires thinking at the basin scale.”

Despite the fact that our model applies at the basin scale, it is very simple. Using only pen and paper, you take geological parameters such as porosity, temperature and pressure to calculate storage capacity,” Szulczewski said. “Other methods suffer from major shortcomings of accuracy, complexity or scale.”

Juanes studies a phenomenon called capillary trapping, through which CO2, liquefied by the pressure of the Earth, is trapped as small blobs in the briny water (picture bubbles of oil in vinegar). The CO2 dispersed throughout the basin’s structural pores eventually dissolves and reacts with reservoir rocks to precipitate out into harmless carbonate minerals.

CO2 has been sequestered in small pilot projects in Norway, Algeria and elsewhere. In 2004, 1,680 tons of CO2 were injected into high-porosity brine-bearing sandstone of the Frio formation 1,500 meters beneath the Gulf coast of Texas. Current proposals call for injecting billions of tons within the Continental United States.

A quicker, easier way to make coal cleaner

Deborah Halber
Civil and Environmental Engineering

Burying the greenhouse gas
New tool could aid safe underground storage of CO2

To prevent global warming, researchers and policymakers are exploring a variety of options to significantly cut the amount of carbon dioxide that reaches the atmosphere. One possible approach involves capturing greenhouse gases such as carbon dioxide at a source — an electric power plant, for example — and then injecting them underground.

While theoretically promising, the technique has never been tested in a full-scale industrial operation. But now MIT engineers have come up with a new software tool to determine how much CO2 can be sequestered safely in geological formations.

The work will be reported Nov. 18 at the 9th International Conference on Greenhouse Gas Control Technologies (GHGT-9), to be held Nov. 16-20 in Washington, D.C.