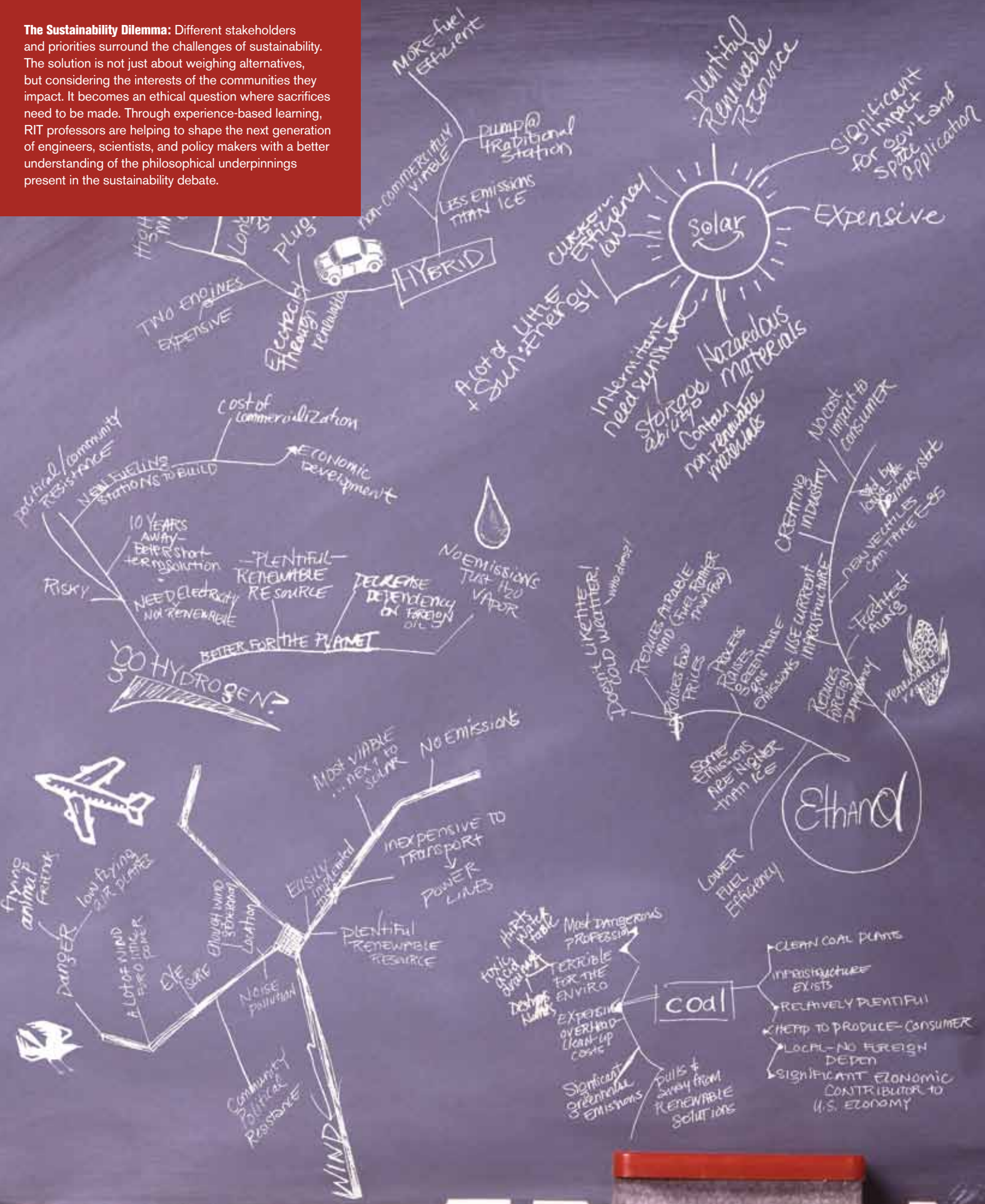


The Sustainability Dilemma: Different stakeholders and priorities surround the challenges of sustainability. The solution is not just about weighing alternatives, but considering the interests of the communities they impact. It becomes an ethical question where sacrifices need to be made. Through experience-based learning, RIT professors are helping to shape the next generation of engineers, scientists, and policy makers with a better understanding of the philosophical underpinnings present in the sustainability debate.



Sustainability Ethics

by Kara Teske

Solutions to address the challenges of sustainability are often bound by contrasting viewpoints. Professors at RIT are developing new educational methods to help influence decisions of future policy makers and innovators.

A Personal Decision—A Global Impact

Every day new evidence reveals the deterioration of renewable resources, the destruction of habitat, and the impact of industrial production on society. In response, engineers, policy makers, environmentalists, and innovators across the world are attempting to develop better ways of using resources and meeting the needs of the Earth's population without negatively impacting the planet for future generations.

However, for these goals to become a reality and less of an ideology, people, businesses, and governments will be required to make sacrifices for the benefit of future generations and communities. How can sustainability be truly implemented if the actual benefits are years away and do not directly affect today's decision makers? This dilemma is one of the central questions of sustainability ethics.

Faculty members at RIT are addressing this question through an international conference and by developing new educational methods in sustainability ethics which will help guide student's problem solving and decision making skills and imbue our next generation of engineers, scientists, and policy makers with a better understanding of the philosophical underpinnings present in the sustainability debate.

Uncovering the Issue

Last spring, RIT hosted a conference on sustainability ethics, which brought together five internationally recognized experts to examine the role ethics plays in sustainability. Co-directed by Dr. Ryne Raffaele, affiliate professor at RIT and director of the National Center for Photovoltaics, Dr. Wade Robison, Ezra A. Hale Professor in Applied Ethics, and Dr. Evan Selinger, associate professor of philosophy; the conference posed five fundamental questions central to the sustainability dilemma.

First, *'Why is sustainability a contested concept?'* "Sustainability is about opposites; it is about tensions. And therein lies part of the contest," says Dr. William Shutkin, director of sustainable development and chair of sustainable development at the University of Colorado at Boulder.

For example, earlier this year, Dr. James E. Hansen, director



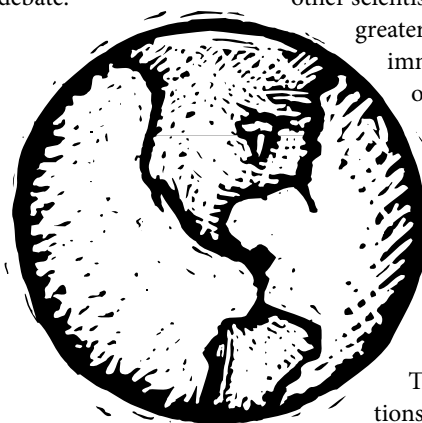
Thought Leader in Sustainability Ethics: Wade Robison, Ezra A. Hale Professor in Applied Ethics co-directed an international conference on sustainability ethics that initiated a dialogue that examined the theoretical and scientific sides of sustainability.

of NASA Goddard Institute for Space Studies, well known for one of the world's first models that predicted much of what is happening with the climate, protested against mountaintop coal mining in West Virginia. His recent modeling efforts, along with other scientists' observations conclude global warming is far greater than he suspected. Hansen believes that unless immediate action is taken, including the shutdown of all the world's coal plants within the next two decades, the planet will experience a devastating climate change.

"This is a classic example of the challenges society is facing that hinder the ability to address these critical issues," says Robison. "Most people who agree with the data that supports Hansen's observations disagree with his approach to the solution.

There are obvious economic and social implications for Hansen's view of simply shutting down the coalmines. The data shows coal mining is not sustainable; the question is what to do about it."

"It is not just about possible alternatives considered in the abstract, but the considerations of real, local interests," explains Selinger. "The local community asks, 'Why should we have to give up our livelihood to solve this global problem when other people aren't required to make equivalent sacrifices?' People





Wind power

Wind power can be used to generate electricity while emitting virtually no greenhouse gases. However, wind farms require significant land mass and can intrude on the surrounding landscape and residents. So, if it's not in my backyard, then where?

Weighing the Issue

- ✓ Emit virtually zero greenhouse gases
- ✓ Inexpensive to generate and transport power
- ✓ Easy to implement since current power grid can be utilized
- ✓ Plentiful natural resource
- ✗ Requires the clearing of large woodland and grass areas to construct wind farms
- ✗ Potential danger for birds and low flying airplanes
- ✗ Tarnish the natural landscape and create significant noise pollution
- ✗ Installation costs high



Hybrid Vehicles

Hybrid vehicles offer a short-term solution to reduce dependency on foreign oil while reducing emissions, but are they worth the cost?

Weighing the Issue

- ✓ Decrease dependence on gasoline/foreign oil
- ✓ Increased fuel efficiency and reduced fuel costs by using electricity and stored energy
- ✓ Reduced emissions compared to internal combustion engine (ICE)
- ✓ Current fueling station infrastructure can be used
- ✗ Expensive to manufacture since hybrids require two engines—one powered by electricity, one powered by gasoline
- ✗ Expensive to own and maintain, cost savings from fuel can take years to recoup
- ✗ Electricity powered through non-renewable source



Coal

Coal represents a significant part of the U.S. economy, but has severe environmental implications. What will it take to preserve the planet and the economy?

Weighing the Issue

- ✓ Significant contributor to U.S. economy; every coal mining job creates an estimated five to eight jobs somewhere else in the economy
- ✓ Produced domestically, no foreign dependency
- ✓ Infrastructure already exists
- ✓ Livelihood for thousands of Americans
- ✓ Inexpensive for consumer
- ✗ Damaging to the environment—impacts soil, water table, and greenhouse gases
- ✗ Toxic acid mine drainage pollutes nearby streams and soil when mines are left abandoned
- ✗ Mine blasts can destroy nearby property
- ✗ Expensive to operate coal mines as a result of requirements passed by legislation

are forced to confront the question of whether their primary obligations are to their families, their local neighbors, or to the global community?"

The second question of the conference examined different viewpoints about *'Why their definition of sustainability is better than alternative accounts?'*

When it comes to sustainability, different stakeholders bound the problem in different ways and define it differently. Take for example the Precautionary Principle, which states—where there is risk of serious harm; lack of full scientific certainty should not be a reason to not take preventative measures. However, what counts as harm, what counts as risk, and how to calculate these risks are all subjective concepts that hamper efforts to address the problem.

Industrialists may see the Precautionary Principle as overly conservative, causing a reduction in economic development that countries need to remain viable and sustainable. However, environmentalists often call for additional precautions to prevent unintended environmental consequences even if it hampers the standard of living for individual communities in the short-run. Policy makers are then required to sift through these differing viewpoints to best meet the needs of their constituencies, needs that may often be different from communities in other regions or countries. So, a mayor in a coal mining community in West Virginia may push to prevent restrictions on coal to protect the sustainability of his community even if the long-term impact of this decision may actually hurt his constituents.

Sustainability—An Ethical Decision

Sustainability has become part of the mainstream media jargon, with slogans like "Go Green" and "Think Globally, Act Locally." But, behind these buzzwords, people are being asked to take responsibility and make decisions that allow them to meet their needs without compromising the ability of future generations to meet their own needs. It becomes an ethical dilemma—should people make sacrifices today for the benefit of future generations?

This leads to the third conference question: *'What is sustainability ethics?'* For years, people have been studying business ethics and environmental ethics; sustainability ethics contains issues from both of these sub disciplines. So, is sustainability ethics an extension of



Solar

The sun is the most abundant energy source on the planet. What will it take to translate this into mass power generation?

Weighing the Issue

- ✓ Solar emits zero emissions
- ✓ Most abundant energy source
- ✓ No cost to generate power once installed
- ✗ Requires a tremendous amount of sun to generate a little energy
- ✗ Intermittency requires there to be significant power storage capabilities
- ✗ Devices contain some hazardous materials and non-renewable resources
- ✗ Development and installation of solar devices is expensive



Hydrogen

Hydrogen fuel cells may hold the future for the next generation of automotive fuel, offering substantial benefits for the environment. What would this mean for the current fueling infrastructure? What about the risks?

Weighing the Issue

- ✓ Decreases dependency on foreign oil
- ✓ Plentiful renewable resource
- ✓ Supports economic development, creating new industry and jobs
- ✓ Only emission is water vapor
- ✗ New fueling infrastructure required
- ✗ High cost of commercialization
- ✗ Risk factors of explosion



Ethanol

The natural resources growing in America's farmlands can be used to generate renewable energy. But is it as efficient, and what does that mean to the cost of food?

Weighing the Issue

- ✓ Can be used by gasoline vehicles in concentrations up to 10%
- ✓ Renewable resources reduces dependency on foreign oil
- ✓ Supports agriculture and rural economic development in the U.S.
- ✓ Inexpensive to produce
- ✗ Lower fuel efficiency
- ✗ Some emissions are actually higher than internal combustion engines
- ✗ Reduces arable land and raises food prices
- ✗ More expensive than gasoline
- ✗ Corn farming and corn-based ethanol production can use nearly as much energy to produce as it supplies

these, or something completely new?

Robison compares the idea of sustainability ethics to the evolution of privacy. Today, privacy is an important legal concept, but before 1893 the idea of privacy as a right did not exist. It took a legal case of a woman who found her photograph on a bag of flour without permission to establish the right to privacy.

“This historical story reminds us that privacy had to be invented into law, until this case no one thought about privacy in this way. Looking back you can identify all the situations and cases in which the right to privacy may have applied. And, perhaps we are seeing a similar evolution with sustainability ethics, it is not necessarily a new idea, but a realization and

understanding of concepts that already exist,” explains Robison.

The issues of sustainability are not just technical issues but issues of values. Sustainability is not just about making more energy efficient things or finding ways to reuse things so they last longer—that is not the full story. Within all of these challenges is a philosophical question that may require people to make sacrifices that might not be a direct benefit to them.

Influencing Sustainability

The experts were finally asked, “*What contributions can philosophers make?*” and “*What are the most important topics of future inquiry?*”

“Philosophers can urge practitioners, policy makers, and citizens to avoid the

pitfalls of objectivism and orthodoxy and encourage curiosity to experiment with different approaches and continuously strive to improve and refine our latest knowledge, methodologies, and technologies in light of the feedback we receive from physical and social reality,” says, Shutkin.

To further analyze and address these questions, faculty members at RIT’s Golisano Institute for Sustainability are developing a series of educational and research programs designed to promote sustainability ethics as an academic discipline.

Sustainability ethics is a key component of the sustainability Ph.D. curriculum, which includes a core course on the subject, taught by Selinger. In addition, through a grant sponsored by the



Experience-based Learning: In partnership with the University of Arizona, Dr. Evan Selinger (left), associate professor of philosophy and Dr. Thomas Seager (right), associate professor at GIS are developing an experiential-based lab to expand the sustainability ethics curriculum at RIT. The class takes classic sustainability problems and places students in the position of an environmentalist, innovator, or regulator so students can experience what it is like to be constrained by interests that drive those roles.

National Science Foundation and in partnership with the University of Arizona, Selinger and Dr. Thomas Seager, associate professor at GIS are working to develop an experiential-based lab to expand the sustainability ethics curriculum at RIT.

“Traditional means of teaching ethics through abstract case studies will not teach students how to handle the competing viewpoints of sustainability. Additionally, students, especially engineers, learn best in experimental and experiential environments where they are able to problem solve and see first hand what happens. This is the vision that has helped to shape the sustainability ethics curriculum at RIT,” explains Seager.

“By creating a virtual environment students can anonymously interact and experiment with different ethical strategies with the only consequence being reflected in their grade. It provides students with a safe environment to experiment in and allows students to learn faster in a more robust way,” adds Seager.

RIT’s sustainability ethics coursework looks at classic sustainability problems and places students in the position

of an environmentalist, innovator, or regulator. Students come in with their own pre-existing ideas of what is right and wrong and through the deliberative cooperative process learn about classic ethical concepts like fairness and justice. Students experience what it is like to be constrained by interests that drive those roles and what kind of deliberations arise.

“The problems are not solvable in the traditional sense—there isn’t one right answer, which for engineers can be frustrating,” notes Seager. With each problem there is a simple mathematical representation and some solutions will naturally be better than others, but there may be multiple workable answers.

“Students will fail, they will get frustrated, they will see the right answer but in order to achieve it they will need to convince everyone of their vision, and that is the sustainability problem,” says Seager. “We know how to reduce energy use, we know how to be greener for the environment, but the challenge is turning it into a reality.”

“At RIT, our goal is provide our students with the education and experiences that will allow them to

become well rounded innovators, so they are not just the best engineers, but are guided by a solid ethical basis for the betterment of their career and the world,” he adds.

Broader Outreach

GIS continues to build on these efforts to bring awareness and understanding of the ethical implications of sustainability. The viewpoints of the experts shared at the sustainability conference are being compiled into a book entitled *5 Questions about Sustainability Ethics*, expected to be released in the spring of 2010.

Following the development of the experience-based lab for sustainability ethics, the team will host a workshop to train other universities throughout North America on how to deliver the course.

In addition, Selinger in collaboration with Danish philosophers and the European Union is co-directing an international sustainability conference next year.



On the Web

More information about this work and other related research is available online.
www.rit.edu/fa/ritgreen
<http://eselinger.org>

Environmental and Economic Systems Management



Amit Batabyal

Dr. Amit Batabyal, the Arthur J. Gosnell Professor of Economics in the College of Liberal Arts, is using dynamic and stochastic modeling techniques to create theoretical models that can

assist in preserving and protecting American rangelands, advancing our understanding of how to manage invasive species, and promoting sustainable economic development in the developing world.

"Economic modeling has traditionally been used to maximize either the utility of individuals or the profits emanating from the optimal management of exhaustible and renewable resources," notes Batabyal. "However, these models do not work well when addressing complex problems in ever changing environments, features that routinely characterize ecological-economic systems such as rangelands."

In response, Batabyal has adapted a series of stochastic modeling techniques from the operations research literature and has used them to analyze ecological-economic systems for which both data and outcomes are uncertain. In the case of rangelands, these modeling techniques are designed to assist managers to better assess how shocks to the system, such

as floods or droughts, will impact grassland, cattle production, and the ultimate survivability of the habitat for future seasons.

"These models will provide more guidance to ranchers on how to maximize profit and yet maintain resilience for the long term, while also assisting environmentalists in preserving the often fragile ecosystems in the American West," Batabyal adds.

Batabyal's research in rangeland management culminated in the book *Stochastic Modeling in Range Management: Selected Essays*, published by Nova Science. It also earned him the "Outstanding Achievement in Research Award" from the Society for Range Management.

Batabyal is now developing stochastic models to better manage the introduction of invasive species in new habitats, through research funded by the U.S. Department of Agriculture. He is also researching ways in which developing countries might better manage their natural resources. Some of this work appeared in the book *Dynamic and Stochastic Approaches to the Environment and Economic Development*, published in 2008.

Through the graduate course, The Economics of Sustainability, which he co-developed as a core course within RIT's doctoral program in sustainability, Batabyal



Rangeland Management: Amit Batabyal, Arthur J. Gosnell Professor of Economics is using dynamic and stochastic modeling techniques to create theoretical models designed to assist managers to better assess how shocks to the system, such as floods or droughts, will impact grassland, cattle production, and the ultimate survivability of the habitat for future seasons.

Photo courtesy of USDA Natural Resources Conservation Service

is working to assist future scientists and engineers in understanding the interactions between ecology and economics.

"These research and education programs will give future policy makers and managers a better understanding of the ways in which today's actions will impact future yields, productivity, and the overall sustainability of resource systems," Batabyal says.

Rochester Clean Energy Education Partnership



Dan Johnson

Earlier this year, the New York State Energy and Research Development Authority (NYSERDA), RIT, and Monroe Community College (MCC) established the Rochester Clean Energy Education Partnership.

This collaboration brings together RIT's College of Applied Science and Technology (CAST) and College of Science (COS) with the Workforce Development division of Monroe Community College to create new college level courses, professional development initiatives, and training programs in alternative energy technology and clean energy development. The courses, offered to undergraduates, graduates, and professional engineers, will promote the continued incorporation of clean energy concepts in traditional engineering and science classes.

"We are engaged with MCC to create a body of knowledge around clean energy technologies, specifically in the areas of wind and solar power, photovoltaics, and fuel cell development,"

says Dr. James Myers, director of the Center for Multidisciplinary Studies in CAST and one of the project's directors.

Five courses are being developed for the program: Principles of Clean Energy Technology, Fuel Cell Power Systems, Fuel Cell Science, Power Systems, and Wind Power Systems.

"The coursework will be used for students in CAST and COS," says Dan Johnson, chairperson of the CAST manufacturing and mechanical engineering technology/packaging science department. RIT faculty from the colleges are currently creating the new courses to serve as technical electives, and will be available to students during the 2009-2010 academic year.

The classes will also serve as the basis for modules that will be developed at MCC in these areas, but focused on skilled trades programming for current production workers in the field," adds Johnson. "Elements of the courses will be worked into modules to develop curricula for skilled trades, particularly HVAC apprentices and electricians, who will work for organizations focusing on renewable energies," says Johnson.

Professional development courses will also include training on new process improvements in materials development, packaging, and energy



NYSERDA Helps to Create Clean Energy Partnership: Francis J. Murray Jr., President and CEO of the New York State Energy Research and Development Authority announced a new partnership that brings together RIT and Monroe Community College to create new college level courses and professional and training programs in alternative energy technology and clean energy development.

efficiencies with an emphasis on improving recyclability and reducing overall energy usage.

"This is just the beginning of what CAST will be doing in this area," says Myers. "The college intends to continue the multi-disciplinary approach to renewable energies and the technologies needed to support this growing field. Resources at RIT make this an ideal location and approach", he added. The team also anticipates the development of a new clean energy lab on campus to eventually interface with the systems and energy grids used in corporations.