

**REgaining our ENERGY Science and Engineering Edge (RE-ENERGYSE)
Funding Profile by Subprogram**

(dollars in thousands)

	FY 2008 Current Appropriation	FY 2009 Original Appropriation	FY 2010 Request
RE-ENERGYSE			
Higher Education	-	-	80,000
Technical Training and K-12 Education	-	-	35,000
Total, RE-ENERGYSE	-	-	115,000

Public Law Authorizations:

- Public Law 95-91, "Department of Energy Organization Act", 1977
- Public Law 101-510, "DOE Science Education Enhancement Act," 1991
- Public Law 109-58, "Energy Policy Act of 2005"
- Public Law 110-69, "America COMPETES Act of 2007"
- Public Law 110-140, "Energy Independence and Security Act of 2007" (2007)

Mission

The mission of the RE-ENERGYSE: REgaining our ENERGY Science and Engineering Edge is to educate the future leaders in energy science and technology and build a highly skilled U.S. workforce who will help develop affordable, abundant and clean energy, thus accelerating the transition to a low carbon economy.

Benefits

The United States is on the cusp of transformational changes in how energy is produced and used. Major investments are being made by the Federal government and industry in clean energy technologies that will create entirely new industries, expand markets for solar, wind and other clean energy sources, and support weatherization and other energy efficiency efforts.

A critical component of a national "green industries/green jobs" effort is to motivate our citizenry to become proficient in science, technology, engineering and mathematics (STEM) and associated energy fields and trades thus ensuring we have a 21st century workforce. The institutions that train that workforce, however, have not yet made the transition that will be required to educate the skilled U.S. workers for emerging trades and research efforts.

At the university level, for example, most of the Nation's 2,500 undergraduate and graduate programs are focused on developing general skills in STEM, and have not seen the kind of enrollment increases we need for a technically literate citizenry over the past thirty years. Very few universities have dedicated programs that will produce highly trained STEM workers with the specific skills and knowledge required by the solar, wind, biofuels and other clean energy industries. The American Association of Community Colleges estimates that less than 10 percent of the Nation's 1,700 community colleges have begun to develop curricula for renewable energy and energy efficiency career tracks, and these programs generally lack national standards and accreditation processes^a. At all levels, from elementary school to post-doctorate programs,

^a American Association of Community College, 2009.

interest in energy and the environment is becoming a critical issue, but students and educators do not have the resources to develop curricula, educational programs, and research opportunities to meet this need.

These shortfalls in education and training are potentially dangerous for the U.S. The Administration identified emerging energy and environmental industries and markets as the leading edge of the U.S. economic recovery effort, as well as the need to train U.S. citizens for the high wage jobs that will become available as DOE's R&D investments create new products, manufacturing/installation processes, and energy infrastructure needs.

However, training each skilled worker takes up to two years at community colleges or up to 10 years at the undergraduate and graduate levels. Furthermore, as the economy evolves, workers from industries of the past need to retrain to deliver adaptive technologies and take advantage of opportunities in clean energy trades. Today's prospering industries can also benefit from technical training that helps "green" these trades so as to efficiently evolve and apply clean energy technologies and processes in their work. Investments must be made now to develop the skilled workforce needed today and in the coming decades. These investments in human capital are essential to ensuring U.S. competitiveness and leadership on clean energy and climate change mitigation.

Other nations are not standing still and are developing industries and training programs designed to support their green energy industries. European countries, for example, control 80 percent of the wind technology market; and most of our toughest competitors are ramping up programs in solar energy, including China, which is projected to become the world's largest supporter of solar with three years.^a On the other hand, the U.S. leads the world in wind installations but has no Masters or PhD program in wind energy, as in Europe. If the U.S. does not begin supporting the workforce that underpins these emerging technologies and markets, the Nation risks becoming a second tier producer of these products on the global market. Such an outcome could also result in the U.S. shifting dependency from one energy input to others.

Contribution to the Secretary's Priorities

RE-ENERGYSE contributes to three of the Secretary's priorities:

Priority 1: Science and Discovery – Invest in science, engineering and technology innovation to achieve transformational discoveries

RE-ENERGYSE addresses basic and applied science through the support of research fellowships and internships at DOE National Laboratories, universities, other research institutions, and the private sector. These fellowships will provide the U.S. research community with a major influx of highly specialized technical expertise that can be brought to bear on bringing new technologies to the marketplace.

Priority 2: Clean Energy – Change the landscape of energy demand and supply

RE-ENERGYSE will help create leading scientists, engineers and technicians who can accelerate the adoption and improve the reliability and performance of clean energy technologies. This will lead to transformational changes in U.S. energy demand and supply that enables the U.S. to achieve a low carbon future.

Priority 3: Economic Prosperity – Create millions of green jobs and increase competitiveness

^a Worldwatch Institute, "Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World," September 2008

RE-ENERGYSE will educate and train Americans to adapt green technology to their industry/trade, and to enter thousands of green jobs and increase U.S. competitiveness. This effort will help universities and community colleges develop leading edge programs, with redesigned and new curricula to produce tens of thousands of other highly skilled U.S. workers who can sustain American excellence in clean energy in industry, trades, academia, the Federal government, and the DOE National Laboratories.

The Higher Education subprogram will result in the development of leading edge undergraduate and graduate programs and between 5,000 and 8,500 highly educated scientists, engineers, and other professionals to enter the clean energy field by 2015; and approximately 10,000 to 17,000 professionals by 2020. By 2015, the Technical Training and K-12 Education subprogram will result in the development of between 200 and 300 community college and other training programs to equip thousands of technically skilled workers for clean energy jobs.

Means and Strategies

RE-ENERGYSE will use various means and strategies to achieve its GPRA Unit Program goals as described below. "Means" include operational processes, resources, information, and the development of technologies; "strategies" include program, policy, management and legislative initiatives and approaches. Various external factors, as listed above, may impact the ability to achieve the program's goals.

RE-ENERGYSE will use the following means and strategies:

- Strategically plan and implement activities by coordinating with experts in education, such as DOE's Office of Science, the Department of Labor, the Department of Education, the National Science Foundation, and the American Academy of Community Colleges, to ensure that this program fills educational gaps and does not duplicate efforts;
- Leverage the capacity of universities, the DOE National Laboratories, and industry to offer educational and research opportunities that will make a critical difference in informing and inspiring students to pursue careers in clean energy;
- Reach out broadly to universities, community colleges, and other relevant institutions to encourage widespread involvement of diverse communities as well as constructive competition to stimulate the development of outstanding programs; and
- Issue competitive solicitations to ensure that high quality institutions have the means and interest to create and sustain education and training efforts.
- Dedicate up to 10 percent of each subprogram to program evaluation activities and peer reviews.

Validation and Verification

To validate and verify program performance, RE-ENERGYSE will:

- Conduct rigorous reviews of individual performance, program effectiveness, and overall programmatic accomplishment of goals.
- Use effective evaluation processes such as pre- and post-program surveys of participants, longitudinal workforce studies to determine program effectiveness, and external reviews conducted by experts in education and training.
- Conduct technical workshops with key stakeholder groups to inform priorities and implementation. Representatives from academia, industry, the Federal government,

professional societies and other stakeholder groups will provide input needed to help effectively carry out and monitor programs.

Following is a summary of validation and verification activities:

- Data Sources: A wide range of education and science organizations (e.g., National Science Foundation, National Center for Education Statistics, National Science Board, Department of Education) to inform the development of program priorities and set specific milestones. To verify the accomplishment of goals and milestones, the program will rely on data collected from grant recipients and other sources as needed, such as pre and post program surveys.
- Baselines: Baselines will be established in FY 2010 through additional analysis.
- Frequency: Annual
- Evaluation: In carrying out the program's mission, RE-ENERGYSE will use several forms of evaluation to assess progress and to promote program improvement:
- Critical peer review of both the program and subprogram portfolios and activities by independent outside experts;
 - Specialized program field metrics and evaluation studies to examine process, impacts, or market baseline and effects, as appropriate;
 - Quarterly and annual assessment of program and management results based performance through Joule (the DOE quarterly performance progress review of budget targets); and
 - Annual review of methods, and re-computation of potential benefits for the Government Performance and Results Act (GPRA).
- Data Storage: On DOE web site
- Verification: Peer reviews and program evaluations

**Higher Education
Funding Schedule by Activity**

(dollars in thousands)

	FY 2008	FY 2009	FY 2010
Higher Education			
Higher Education	-	-	80,000
Total, Higher Education	-	-	80,000

Description

The Higher Education subprogram will support fellowships, internships, post-doctoral opportunities and the development of interdisciplinary masters programs in the area of clean energy. In particular, this subprogram will offer up to 200, three-year fellowships for graduate students in engineering and other relevant fields. This subprogram will also fund up to 200 post-doctoral opportunities that will allow exceptional students to apply their skills in a laboratory setting devoted to clean energy topics. It will also fund up to 1,000 assistantships for undergraduate students to support a summer research project as well as continued study in the clean energy field with participating faculty members. Additionally, this subprogram will support the development of approximately four interdisciplinary masters programs in clean energy.

Benefits

These efforts will result in hundreds of highly qualified candidates entering into the clean energy field through various disciplines. These activities will make competitive awards to ensure support for the superior proposals, programs, and individuals. The development of an effective education pipeline will serve the needs of a growing clean energy field to ensure U.S. leadership in energy and climate change mitigation.

These opportunities for undergraduates, graduate, and post-doctoral students will support between 900 and 1,600 U.S. citizens per year who will contribute to the invention and commercialization of advanced clean energy technologies, including net zero energy buildings; inexpensive nanotechnology-based solar cells; energy storage for advanced electric cars; and smart grid technologies. Higher education programs focused on clean energy, along with funded research opportunities, will encourage students to pursue careers in clean energy research, industry, academia, and government.

Undergraduate internships for U.S. students are vital to ensuring U.S. leadership in STEM fields. Enrollment by U.S. students in STEM graduate programs from 1996 to 2006 has been relatively flat (less than one percent increase in 10 years), while foreign student enrollment in U.S. graduate programs increased by 31 percent during the same time period.^a This subprogram's efforts in increasing the supply of U.S. STEM undergraduates interested in energy and environmental research is critical to developing a sustained pipeline of skilled energy workers for U.S. industry, academia, and U.S. research institutions.

^a National Science Foundation, Division of Science, Resources and Statistics, "Survey of Graduate Students in Post-Doctorate in science and Engineering," Table 1, 2007

Detailed Justification

(dollars in thousands)

FY 2008	FY 2009	FY 2010
—	—	80,000

Higher Education

The Higher Education subprogram is dedicated to the development of scientists, engineers, and other professionals with the skills needed to enter into the clean energy field. For all of the competitive activities funded under this subprogram, widespread outreach will be conducted at U.S. universities, scientific professional societies, and other organizations with relevant student populations. Priority will be placed on recruiting applicants from under-represented populations and applicants attending Minority Serving Institutions (MSIs). Activities within this subprogram include post-doctoral fellowships, graduate fellowships, interdisciplinary masters program, and undergraduate research internships.

The Post-Doctoral Fellowships will support between 150 and 200 post-doctoral one-year fellowships in various energy science and technology fields, with particular emphasis on energy efficiency, renewable energy, and other clean energy topics, at DOE National Laboratories, research institutions, and industry. Eligible applicants will include recent graduates as well as other professionals with a relevant Ph.D. who are interested in moving into the clean energy field. Therefore, this represents an opportunity for the clean energy sector to attract not only new doctoral students but also highly educated scientists in related fields.

These post-doctoral fellowships will fill a compelling need within clean energy and DOE workforce development pipeline. A 2008 NSF survey^a found that of the 1,718 postdoctoral students working at DOE National Laboratories, only 39% (664) were U.S. citizens. This confirms recent reports by the National Academies of Science^b that U.S. citizens are not pursuing STEM careers in numbers equal to those of other nations. The goal of the post-doctoral fellowships is to increase the number of U.S. citizens pursuing and obtaining STEM degrees and careers.

The Graduate Research Fellowships will support between 150 and 200, three-year fellowships leading to a Ph.D. in science, engineering and other fields such as chemistry, materials science, or computational sciences, with a particular emphasis on clean energy topics. Fellowships will provide up to three years of support over a maximum of five years, and will pay for tuition and fees at a U.S. university, travel associated with the student's research, and an annual stipend. Research fellowships will be encouraged at DOE National Laboratories, other research institutions, and at industries that conduct research in clean energy technologies. Applicants will be competitively selected by external reviewers based on an evaluation of each application against established criteria, such as the student's academic performance and interest in clean energy research.

The Masters Program in Interdisciplinary Energy Studies will solicit applicants through a competitive process offered only to U.S. universities. This activity will also support the

^a National Science Foundation, "Survey of Postdoctorates at Federally Funded Research and Development Centers," November 2008

^b National Academies of Science, "Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Future," 2005

(dollars in thousands)

FY 2008	FY 2009	FY 2010
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development of approximately four Clean Energy University Collaborations (CEUCs) per year across the U.S. These CEUCs will develop and offer two-year programs of study in various fields including science, engineering, public policy, economics, architecture, and business. The CEUCs will support curriculum development, equip laboratories, train students, develop faculty lecture series, and dedicate specific resources to encourage innovation in the clean energy field. In addition, each CEUC will participate in an annual national student business plan competition project.

Each CEUC will offer a master's degree in "Interdisciplinary Energy Studies" related to the solution of energy problems and the advancement of energy efficiency and clean energy. The interdisciplinary master's program will require coursework in the selected discipline as well as courses focusing on public policy and economics, specialized study in energy engineering or a related energy field, energy laboratory experience, completion of a final year business plan competition project, and a part-time or summer student internship at a DOE National Laboratory, a private sector research firm, or other laboratory. Given high and growing industry demand for professionals with cross-cutting energy training, these graduates will be particularly valuable.

Currently, 143 professional science master degree programs exist at 70 U.S. universities, but none of these programs focus on interdisciplinary energy studies. The professional science masters was first introduced in 2000 in the U.S. and is one of the fastest growing segments of STEM graduate education, currently producing more than 3,000 graduates per year. Ninety percent of those graduates are recruited immediately into industrial or government employment, with the rest pursuing PhDs. This activity would support the development of professional science masters programs, specifically dedicated to clean energy studies.

The Undergraduate Internships will support up to 1,000 research appointments for undergraduate students. This activity will make competitive awards to students to participate in individually mentored research in the clean energy field. Internships can be carried out at universities, industry, and DOE National Laboratories. Through these internships, students will become a part of the research community and a source of energy innovation for DOE and the U.S.

Students will apply on a competitive basis, and will then be matched with mentors working in the student's fields of interest. The participating students will spend an intensive 10 to 16 weeks working under the individual mentorship of resident scientists, produce a peer-reviewed abstract and research paper, and attend seminars that broaden their view of energy science careers and help them understand how to become members of the energy research community. Students must also develop a coordinated plan to continue their work during the academic year, at their host university, at a DOE National Laboratory, or through a private-sector opportunity. This activity will provide hands-on experience and academic mentoring for a large group of students to improve their expertise and ability to make early contributions as they move toward careers in the clean energy field.

In FY 2010, activities will focus on setting up the process and structure of the subprogram and developing the process for issuing competitive solicitations for all of the higher education efforts for implementation in the 2010/2011 academic calendar year.

Total, Higher Education

— — 80,000

Explanation of Funding Changes

FY 2010 vs. FY 2009 (\$000)

Higher Education

The increase reflects the proposed initiation of the new program.

+80,000

Total Funding Change, Higher Education

+80,000

**Technical Training and K-12 Education
Funding Schedule by Activity**

(dollars in thousands)

	FY 2008	FY 2009	FY 2010
Technical Training and K-12 Education			
Technical Training and K-12 Education	-	-	35,000
Total, Technical Training and K-12 Education	-	-	35,000

Description

The Technical Training and K-12 Education subprogram will support the development of effective training programs at community colleges and other training centers. Competitively-selected community colleges and other training institutions will develop up-to-date, technically accurate, curricula as well as faculty training that will focus on solving the Nation’s energy challenges. Training and educational programs will be designed to meet current and near-term local market needs for a green workforce. This subprogram will also include activities designed to engage and empower K-12 students and educators to help meet the Nation’s energy and environment challenges.

Benefits

Community colleges account for over 40 percent of U.S. undergraduate enrollment and enroll a majority of under-represented students in STEM. However, less than 10 percent of the Nation’s 1,700 community colleges offer courses in “green technology.” Those that do offer such courses, with the exception of the solar industry, lack national certification processes.

Expanding the ability of community colleges and other institutions to provide technical training and certification is a critical factor in ensuring that American workforce is scaled up and adequately trained to implement new and advanced energy technologies. Furthermore, community colleges and training centers remain a largely untapped but highly viable avenue to increase participation of under-represented as well as lower-income populations in STEM clean energy careers.

As Silicon Valley took advantage of the technical education provided by the California Community College system, the Nation must now look to community colleges to provide American workers with the necessary skills to advance energy efficiency and clean energy in the marketplace. This subprogram will ensure excellence in technical training for workers interested in entering clean energy trades. Approximately 35 to 55 technical training programs will be established each year with the capacity to train up to 3,000 highly skilled technicians each year to enter the clean energy field.

The subprogram will also reach thousands of K-12 students and educators with campaigns, curricula, competitions, and other efforts aimed at inspiring students to pursue clean energy careers and adopt sustainable energy practices that are necessary to mitigate climate change.

Detailed Justification

(dollars in thousands)

FY 2008	FY 2009	FY 2010
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Technical Training and K-12 Education	-	-	35,000
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Technical training grants will be awarded through both competitive and peer reviewed processes. This subprogram will offer competitive grants to between 35 and 55 community colleges and other training institutions to develop certificate programs to train up to 3,000 U.S. technicians and faculty per year in STEM subjects with a focus on clean energy technologies, processes, and applications. Selected institutions will develop appropriate curriculum, equip laboratories, train students and faculty in clean energy fields. In addition, students and faculty at these institutions will be eligible for research internships at DOE National Laboratories, industry, and academic institutions. In FY 2010, activities will focus on setting up the structure for the competitive grants, including the development of application criteria, establishing a review process, and outreach to community colleges and other training institutions.

The K-12 Education activity will work with U.S. K-12 students and educators who are eager to contribute their ideas to the solution of long-term environment and energy challenges, but often do not have adequate knowledge about the issues or potential career opportunities. These activities will be aimed at inspiring the next generation of Americans to pursue careers in science and energy, as well as teach young students the importance of sustainable energy use in their daily lives and choices.

At the onset, DOE will seek input from a wide range of stakeholders and experts to formulate a strategy specifically targeted at enhancing K-12 interest in and understanding of science, technology, and clean energy more specifically. All K-12 targeted activities will be coordinated with educational efforts across DOE and other federal agencies. In addition to the federal sector, DOE will reach out to private and non-profit organizations involved in science education to avoid duplication and build on other effective programs.

One objective will be to excite K-12 students about how energy professionals are developing solutions to important problems associated with energy use such as climate change. Through real world examples, students will enhance their scientific literacy; and learn how they can help solve the tough challenges ahead by considering careers in energy and science.

This effort will rely on innovative approaches to engage the nation's K-12 students and teachers. For example, activities might take advantage of multimedia and modern communication technologies that younger generations most commonly use (e.g., text messaging, Twitter, You-tube, video games). As another example, DOE may issue a challenge to students and educators to identify and implement creative ways to reduce the energy use of their schools and move toward zero-carbon footprint and energy efficient buildings. Such a challenge or competition could culminate with a national showcase at a public event (e.g. Earth Week) where school teams would display their ideas, share results and experiences, learn from experts, and celebrate their successes.

Total, Technical Training and K-12 Education	-	-	35,000
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Explanation of Funding Changes

FY 2010 vs. FY 2009 (\$000)

Technical Training and K-12 Education

The increase reflects the proposed initiation of the new program.

+35,000

Total Funding Change, Technical Training and K-12 Education

+35,000