

GOING GREEN



The Vital Role of **COMMUNITY COLLEGES** in Building
a Sustainable Future and **GREEN WORKFORCE**





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a Sustainable Future and **GREEN WORKFORCE**

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INTRODUCTION

An ever-growing body of scientific evidence suggests that climate change and ecosystem degradation are urgent threats to the environmental, social, and economic health of our communities. Many of the climate disruptions and ecosystem changes in recent decades are the result of human activity intended to meet our growing demands for food, fresh water, fiber, and energy.^{1, 2}

To prevent the most catastrophic outcomes of global warming and to build a sustainable society – one that incorporates values, systems, and activities that are environmentally sound, socially just, and economically viable – requires bold and immediate action. Leading climate scientists and other experts have recommended the necessary steps to slow or reverse humanity's impact on climate change trends that will help build a low-carbon, clean energy economy. These recommendations include combining short-term strategies – conservation, efficient use of resources, and use of renewable resources – with long term investments in clean technology research and sustainable development strategies.^{3, 4, 5, 6}

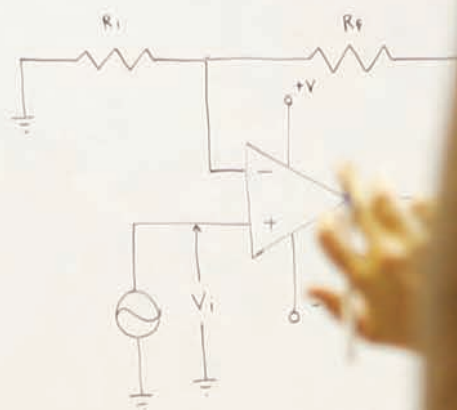
The emerging transition to a low-carbon and sustainable economy holds great promise for economic growth and prosperity, innovation, and job creation. New green technologies and discoveries – coupled with new demand and forward-thinking public policies that advance sustainability and encourage public-private investments – are starting to transform the economic landscape as products, services, and jobs are reoriented toward a greener future.⁵



Community colleges are at the forefront of this growing momentum for action on climate change, sustainability, and green workforce development. Across the country, colleges are exercising leadership and meeting their social mandate to create a thriving, healthy society by modeling ways to eliminate global warming emissions, creating living classrooms on campuses, integrating sustainability principles into curricula, and educating and preparing workers for new, reoriented, or emerging jobs in the clean energy economy.^{7, 8}

This report examines the growing role of community colleges in a low-carbon, clean energy economy, and:

- provides examples of innovative strategies and practices used by community colleges to address climate change, environmental stewardship, and green workforce development;
- offers information on the fastest growing sectors and jobs in the clean energy/green economy that provide strategic opportunities for community colleges and their students;
- stimulates the dialogue on the role of community colleges in creating a sustainable future; and
- presents useful Web sites and resources for further information.



Addressing Climate Change and Promoting Sustainability

Due to their enormous impact on the nation's workforce, economy, and environment, community colleges are well positioned to provide leadership in implementing climate solutions and modeling sustainability on campuses. Of even greater influence are the millions of community college students who will develop the necessary skills and knowledge to lead the country's transition to a low-carbon future.

To that end, a growing number of community colleges are focusing their attention on developing solutions to global warming and showing an unprecedented commitment to sustainability. Many community colleges are among the more than 600 higher education institutions that have signed the American College and University Presidents Climate Commitment, a formal pledge that includes:

- Developing a comprehensive plan to achieve climate neutrality; setting a target date and interim milestones, and creating mechanisms for tracking progress toward the goals;
- Completing a comprehensive inventory of all greenhouse gas emissions (including electricity, heating, commuting, and air travel) and updating the inventory every other year;
- Establishing a policy requiring that all new campus construction be built to at least the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) silver standard or its equivalent;
- Beginning to purchase or produce at least 15 percent of the institution's electricity consumption from renewable sources;
- Encouraging use of, and providing access to, public transportation for faculty, staff, students, and visitors;
- Participating in the waste-minimization component of the national RecycleMania competition and adopting three or more associated measures to reduce waste; and
- Making the institution's action plan, emissions inventory, and periodic progress reports publicly available.³



For additional information about the American College and University Presidents Climate Commitment, and a list of the two- and four-year institutions that have signed it since 2006, go to www.presidentsclimatecommitment.org.

Increasingly, sustainability principles and practices are guiding community colleges' decisions on management, planning, resource allocation, curricula, programming, research, external partnerships, and professional development. Many initiatives focus on energy-consuming buildings and infrastructure, which can account for 70-90 percent of a school's greenhouse gas emissions.⁹ These initiatives range from building state-of-the-art structures with zero-waste, energy-neutral designs, to whole-campus approaches to energy efficiency that use solar, wind, and geothermal sources. Colleges are also using their campuses as "living laboratories" that provide the foundation of learning, offering opportunities for innovative, interdisciplinary approaches, and valuable hands-on experience for students, faculty, and staff.

The following are examples of sustainability efforts on campuses:

> **Mount Wachusett Community College (MWCC), Gardner, Massachusetts**, was at the forefront of the climate movement when it converted its all-electric main campus to a biomass heating system, which uses wood chips as fuel to slash utility expenses and greenhouse gas emissions. The conversion has reduced the college's carbon footprint by 22.5 percent, cut electricity usage by 38 percent, reduced water usage by 52 percent, and achieved cost savings of \$2.93 million. MWCC was able to implement this \$4.3 million conversion at zero net cost to the college through the creative use of federal and state grants and a performance contract with the energy service company NORESKO. MWCC's energy savings provide a significant environmental and health benefit by reducing air pollutants. Cumulative emissions reductions include 11,000 tons of carbon dioxide, 18 tons of nitrogen oxide, and 47 tons of sulfur dioxide. The conversion is paving the way for other green energy initiatives on campus, including solar, wind, and geothermal. For more information, contact: Robert Rizzo, Director of Sustainability and Energy Policy at (978) 630-9137 or rrizzo@mwcc.mass.edu.

> **John Wood Community College, Quincy, Illinois**, installed a geothermal heating and cooling system in its new student activity center that saves 540,000 kilowatt (kW) hours of energy – and about \$25,000 in costs – each year. For more information, contact: Lou Barta, Director of Physical Plant at (217) 641-4215 or lbarta@jwcc.edu.

> **Lakeshore Technical College, Cleveland, Wisconsin**, taps into the windy shoreline of Lake Michigan with a turbine that yields 50,000 kW hours of energy a year and supplies one to two percent of the campus' electrical energy. The turbine, which was constructed in 2004, is used for technical training, workshops, seminars, and courses on renewable energy systems. For more information, contact: Jennifer Heinzen, Electrical Apprenticeship & Wind Energy Instructor at (920) 693-1267 or jenny.heinzen@gotoltc.edu.

> **Chandler-Gilbert Community College (CGCC), Chandler, Arizona**, began using reclaimed water at its Pecos campus for virtually all of its irrigation needs in January 2008. The college also installed waterless and low-flow fixtures in all restrooms. An expanded, campus-wide recycling program for aluminum and plastic bottles, cardboard, and paper was instituted in 2007. In addition, the college recently completed its first LEED Silver building, which includes a 15 kW photovoltaic system, and all future development will meet LEED Silver certification standards. In recognition of CGCC's efforts toward sustainability, the Association for the Advancement of Sustainability in Higher Education awarded the college its 2007 Sustainability Leadership Award for two-year institutions. CGCC is also a charter signatory to the President's Climate Commitment and is now acquiring 15 percent of its energy from renewable sources. For more information, contact: Bruce Scharbach, Acting Director & Sustainability Coordinator at (480) 857-5560 or Bruce.Scharbach@cgcmail.maricopa.edu.

> **Wake Technical Community College, Raleigh, North Carolina**, received a 2008 Innovation of the Year Award from the League for Innovation in the Community College in recognition of its Northern Wake Campus – the first all-LEED campus in the nation – for its creativity, quality, efficiency, and cost effectiveness. The Northern Wake Campus buildings were constructed according to the strictest environmental standards set by the U.S. Green Building Council. The campus operates in accordance with those standards from initial site planning to water and energy management, material use, and indoor air quality monitoring. To date, the \$45 million campus has saved more than \$100,000 through sustainable practices, reduced water and energy use by 20 percent and 30 percent respectively, and cut down on construction waste by 50 percent. The college's construction management associate degree program uses the Northern Wake Campus as a lab setting where students learn both conventional building methods and materials, and those elements of sustainable construction that have helped Wake Tech earn LEED certification. For more information, contact: Laurie Clowers, Director of Public Relations at (919) 866-5929 or lcclowers@waketech.edu.

Lane Community College

EUGENE, OREGON

Few postsecondary institutions have made a more substantial commitment to climate change and promoting environmental stewardship than Lane Community College. Four years ago, Lane set a goal of becoming carbon-neutral by 2050, hired a full-time sustainability coordinator, and established benchmarks and mechanisms for tracking the progress and impact of its efforts over time.

The college, which already purchases 10 percent of its electricity from renewable sources, has implemented a variety of energy-conservation measures on its campuses in Eugene, Cottage Grove, and Florence, Oregon. To date, students at the college have installed nearly five kW of photovoltaic arrays on campuses, including a one kW system that serves the college's child care center. Student volunteers also helped retrofit water faucet aerators from 2.2 gallons per minute (gpm) to between 0.5 and 1.5 gpm.

Lane's motor pool and maintenance fleet is being converted to energy-efficient and alternative-energy vehicles, and students on the main campus receive a free bus pass as part of a cooperative plan with the Lane Transit District. The college has a comprehensive recycling program that includes paper, cardboard, metal, plastic, glass and wood, and an in-vessel composter that processes more than 13 tons of food trimmings, sawdust, and other materials each year. Reuse opportunities include a clothing exchange for students and an office-supply exchange for faculty and staff.

In addition to the Associate in Applied Science (A.A.S.) degree programs in renewable energy technology, water conservation, and energy management, Lane offers cross-disciplinary courses such as global ecology, environmental politics, and natural resource economics; continuing-education courses ranging from sustainable landscaping to voluntary simplicity; and extracurricular activities that include a Green Chemistry Club and environmental/earth science field trips. There are approximately 90 first-year students enrolled in these programs annually. Nearly all of Lane's graduates are placed in related jobs around the country and the college has begun to assist other community colleges in developing similar programs.

Lane is also home to the Northwest Energy Education Institute, which provides energy- and building-related continuing education across the U.S. Courses include the Energy Management Certification, Building Operators Certification, Bonneville Power Administration Residential Auditor Certification, and National Sustainable Building Advisor Program. Early last year, Lane hosted the first Conference on Sustainability for Community Colleges, which included representatives of more than 40 colleges from 16 different states.



To learn more about the scope, progress, and impact of Lane's sustainability initiatives, go to www.lanecc.edu/sustainability/susprog.html or contact Jennifer Hayward, Sustainability Coordinator at (541) 463-5594 or haywardj@lanecc.edu.



The Los Angeles Community College District

LOS ANGELES, CALIFORNIA

The Los Angeles Community College District (LACCD) has set its sights on becoming the first community college system in the nation to generate all of its own electricity as it undertakes one of the largest public sector sustainable building efforts in the United States. LACCD's \$5.7 billion budget came from bond referendums to renovate and modernize all nine college campuses, making the

district's program one of the largest in the world. In 2002, the LACCD adopted a sustainable renewal policy mandating that all new buildings that receive 50 percent or more in bond funding be constructed according to LEED certification standards. The district is the first in the nation to adopt such a policy.

LACCD has received a host of awards since its green building program began, including the 2007 Governor's Environmental and Economic Leadership Award, California's highest environmental honor, and the 2007 Clinton's Climate Initiative Award for its efforts to dramatically reduce greenhouse gas emissions by modernizing campus buildings. Currently, more than 200 projects are underway, and 44 new buildings are completed, under construction, or planned. When construction and modernization is complete, all nine colleges will have new LEED-certified buildings and will be energy independent and carbon neutral.

The first phase of the district's Renewable Energy Plan calls for installing one megawatt of solar electric capacity – enough to power 1,000 homes – at each of the district's nine campuses over the next couple years. The plan also includes the installation of enough photovoltaic panels, geothermal energy technologies, and wind turbines on each campus to address all its electricity needs. Some strategies include using renewable sources, retrofitting the campuses to make them more energy efficient, and developing green power to reduce the colleges' energy costs.

The district is also partnering with four-year colleges, businesses, public schools, and unions to foster the creation of green jobs and certification programs to meet the growing needs of industry. LACCD is now creating a state-certified sustainable development curricula, and training students for jobs in a number of green fields including architecture, business, construction, design, transportation, and utilities. Academic programs and courses are aligned with the emerging green technology industries that have the highest potential for job growth in the Los Angeles area.

LACCD's commitment to implementing cutting-edge green technologies in its sustainable building program offers students an invaluable opportunity to learn in a living laboratory that incorporates practical hands-on experiences into its green jobs curricula.^{10, 11}



For more information, visit www.laccdbuildsgreen.org or contact MWW Group at (213) 486-6560 or info@laccdbuildsgreen.org.

> **Virginia's Tidewater Community College (TCC), Portsmouth, Virginia**, owns 69 acres of natural land near the Chesapeake Bay, which include an upland island separated from the main campus by a tidally influenced estuarine marsh. An Audubon Sanctuary, this environmental treasure has become an outdoor classroom used by faculty from many disciplines including English, science, and history. The college has a history of helping to sustain the environment through educational programs and good conservation practices. TCC academic programs incorporate environmental issues into areas such as biology, alternative automotive fuels, "green" interior design, and sustainable practices in horticulture. The college also uses modeling and simulation across a range of disciplines including police training, trucking, and engineering, all in an effort to reduce their carbon footprint by incorporating the best practices in today's careers. For more information, contact: Tidewater Community College Information Center at (757) 822-1122 or tccinfo@tcc.edu.

> **Manchester Community College, Manchester, New Hampshire**, is building the first LEED-certified automotive training facility in the country. The Automotive Science and Technology Center will incorporate a variety of strategies to increase energy efficiency and reduce environmental impact, including a rainwater-collection mechanism for flushing toilets and urinals to reduce potable water demand, a daylight-harvesting system with 48 tubular skylights designed to turn off electric lighting, in-slab radiant-heating for better thermal comfort, high-efficiency boilers and heat recovery units, and solar panels to heat water. The Center will support the college's growing automotive-technology programs and by highlighting the use of new materials and the need for lifestyle changes, it will also raise awareness and educate students, faculty, and staff about the sustainable design movement. All cleaning agents used by students will be water-based and biodegradable, and an area will be designated for recycling items such as metal, aluminum, paper, and glass. For more information, contact: President Darlene G. Miller, dgmiller@ccsnh.edu.

Although climate change presents tremendous challenges, it also offers many opportunities for colleges. As reported in the National Wildlife Federation's Campus Ecology Guide, these important opportunities include:

- savings from energy conservation;
- stabilization of energy costs and supply;
- compliance with mandates or pending regulations;
- new education and career opportunities; and
- new funding sources.⁸

Global climate change also provides community colleges the opportunity to reach out beyond their campuses and build stronger community relationships by offering information and forums on mitigating climate change and providing venues for collaborating on climate solutions. And lastly, climate change provides new avenues for student engagement. Because of their own concerns about the environment, students have become a galvanizing force on campuses, forming student action groups, conducting peer workshops, and actively engaging in campus sustainability efforts.

Educating and Preparing America's Green Workforce

“So who will do the hard and noble work of actually building the green economy? The answer: millions of ordinary people, many of whom do not have good jobs right now. According to the National Renewable Energy Lab, the major barriers to a more rapid adoption of renewable energy and energy efficiency are not financial, legal, technical, or ideological. One big problem is simply that green employers can't find enough trained, green-collar workers to do all the jobs.”

– Van Jones, *The Green Collar Economy*¹²

As climate solutions and the integration of sustainability practices are implemented on campuses, community colleges are also taking a leadership role in educating and training a workforce for the clean energy/green economy. Community colleges - with their connections to local and regional labor markets and the flexibility to respond to emerging industries and their changing skill needs - are the perfect gateway to good green jobs, preparing workers with the skills and competencies needed for green industries, and ensuring that these industries do not face a shortage of adequately trained workers.

Many of the green jobs for which community colleges are, or will be, preparing workers span several key economic sectors including renewable energy, buildings and construction (energy efficiency), transportation, manufacturing, agriculture, and forestry. Green jobs, as broadly defined



in a report commissioned by the United Nations Environment Programme, contribute significantly to preserving or restoring environmental quality and could include, but are not limited to:

- helping to protect ecosystems and biodiversity;
- reducing energy, materials, and water consumption through high-efficiency strategies;
- de-carbonizing the economy; and
- minimizing or avoiding the production of waste and pollution.⁶

As the move toward a low-carbon and sustainable economy takes hold, the primary clean energy sectors of efficiency, renewables, and alternative fuels and transportation have emerged as offering the greatest potential for job creation and growth,^{4, 5, 13} and perhaps, the greatest workforce development opportunity on the horizon for community colleges. Although it is difficult to quantify, a report produced for the American Solar Energy Society indicates that the renewable energy and efficiency industries generated 8.5 million jobs in 2006. Optimistically, these sectors may account for as many as one in four jobs, direct and indirect, by 2030.¹³

Summary of the U.S. Renewable Energy and Energy Efficiency Industries in 2006

| INDUSTRY | Revenues (billions) | Direct Jobs (thousands) | Total Jobs (Direct and Indirect) Created (thousands) |
|-------------------|------------------------|----------------------------|---|
| Renewable Energy | \$39.2 | 196 | 452 |
| Energy Efficiency | \$932.6 | 3,498 | 8,046 |
| Total | \$971.8 | 3,694 | 8,498 |

Source: American Solar Energy Society and Management Information Services, Inc, 2007



Green jobs in clean energy sectors span a variety of skills, educational backgrounds, and occupations. However, many jobs that are currently, or predicted to be, in demand are “middle-skilled” jobs that require more than a high school diploma but less than a bachelor’s degree.⁵ It is important to note that although there will be a growing number of new green occupations requiring new knowledge, skills, and abilities, it is expected that the majority will be transformed from existing jobs, requiring a redefinition of skill sets, methods, and occupational profiles.^{5, 6} From a community college perspective, this means that while some emerging green occupations will require the creation of new industry-recognized credentials and training programs, many will only require modifications to existing programs and courses to integrate green skills. Similarly, as new career pathways are developed specific to renewable energy, the majority of job trajectories in green industries will be built into traditional career pathways.⁵ Even so, community colleges are strategically positioned, with regional partnerships, to create the framework for new and expanded green career pathways, to work with employers to redefine skills and competencies needed by the green workforce, and to support professional development in these evolving occupational fields.

As community colleges seek to identify the strategic opportunities of these green sectors, gathering specific and accurate labor market information about the green jobs in demand is critical and challenging. Much of the data on high-growth, high-demand occupations for the new energy economy is not easily obtained because many of the forces (policies, investments, etc.) that drive change are still very much in flux. In addition, many of the occupations in green industries are not listed as such in the Bureau of Labor Statistics standard occupational codes (SOC), adding to the difficulty of understanding job growth and industry needs.^{5, 15} As a result, community colleges may find it beneficial to collaborate with workforce and economic

development entities that may be able to customize local labor market information, survey regional employers, or develop industry-specific economic impact models that highlight major investments in these industries in the region.





Fast-Growing Sectors of the Clean Energy Economy

Energy Efficiency – Buildings and Construction

Energy efficiency, particularly in buildings and construction, is one of the areas with the highest potential to reduce greenhouse gas emissions and, at the same time, create a significant number of jobs.^{1, 16} Residential, commercial, and public buildings account for 38 percent of U.S. carbon dioxide emissions, and consume 72 percent of the nation's energy, according to the U.S. Green Building Council.¹⁷ Greening the building sector can mostly be accomplished with existing technology and typically offers outstanding returns on investment. The energy-efficiency sector encompasses a wide range of activities including: green-building design and construction; renovation and retrofitting of existing buildings; energy management; and manufacture of products needed for these activities.

Many of the jobs in the green building sector will require the reorientation of existing jobs. For example, a company that retrofits and updates the heating, cooling, and lighting systems of a building will need a construction worker with traditional skills who is also trained in the most recent energy efficiency methods.⁵ To that end, many community colleges traditionally offer programs in construction that could be easily adapted to train workers for green building design, renovation, and construction. Energy efficiency occupations are very accessible to community college students, as many jobs require no more than an associate degree, are at the technician-level, and have the potential of career advancement through attainment of certifications.¹⁵



SPOTLIGHT ON JOBS IN ENERGY EFFICIENCY^{5, 15, 18, 19}

- Systems Technician
- Green Designer and Architect
- Skilled Energy-Efficient Construction Trade Worker such as Carpenter, Electrician, Plumber
- Resource Conservation/Efficiency Manager
- Energy and Indoor Air Quality Auditor
- Heating, Ventilation, and Air Conditioning (HVAC) Operation and Maintenance Technician



Leadership in Energy and Environmental Design (LEED)

According to the U.S. Green Building Council, the LEED Green Building Rating System encourages and accelerates global adoption of sustainable green building and development practices through the creation and implementation of universally understood and accepted tools and performance criteria.²⁰ Buildings earn a LEED certification and green building professionals can become LEED-accredited through the LEED Accredited Professional Exam. Community colleges are using a variety of training mechanisms that incorporate LEED sustainable green building practices into their curricula and some colleges are also providing training to incumbent workers on the work site and offering classes to become LEED-accredited professionals. Increasingly, new building codes require LEED standards, which will compel job creation and upgrade training of incumbent workers.¹⁵

Renewable Energy

Solar Energy

Solar technologies are broadly characterized as either passive or active depending on how they capture, convert, and distribute sunlight. Active solar technologies include photovoltaics and solar hot water. Photovoltaics convert sunlight directly into electricity. Solar hot water systems circulate a working fluid to collect thermal energy and then transfer this heat to the hot water supply. Solar hot water generally uses pumps or fans to circulate the material. Passive solar techniques include orienting and constructing buildings to take advantage of the sun for heating, cooling, and lighting interior spaces; selecting materials with favorable thermal properties; and designing spaces that naturally circulate air. Several states have enacted legislation to spur solar energy installation and development, notably California, New Jersey, and Massachusetts. California has implemented an aggressive plan to become the nation's leader in solar energy, with a goal of installing 1 million solar roofs – and 200,000 home and commercial solar water-heating systems – by 2018.²¹

The solar energy industry has a high potential for job growth and large economic impact. Clean Edge, a research and publishing firm providing information on clean technologies, predicts that solar photovoltaics, including modules, system components, and installation, will grow from a \$20.3 billion industry in 2007 to \$74 billion by 2017.²² The solar industry currently estimates that for every megawatt (MW) of installed solar power, approximately 35 people are employed, which includes jobs in both manufacturing and installation.²³ Employers often hire entry-level solar installers with a construction background and provide on-the-job, short-term training, with good potential for career advancement. The most common and highly recognized certification for renewable energy is in the solar sector from the North American Board of Certified Energy Practitioners.²⁴

As the potential for jobs grows in the solar industry, community colleges can increase enrollment by connecting courses and certifications to their existing construction and engineering programs and promoting careers in the solar industry to new or returning students who have worked in construction-related fields.



SPOTLIGHT ON JOBS IN SOLAR ENERGY ^{18, 25, 26}

- Solar PV System Installer
- Solar Thermal System Installer
- Sales Representatives/Estimator
- Site Surveyors/Assessor
- Solar Engineer/Designer
- Solar Installation Manager/Project Foreman



Wind Power

Wind farms can generate enough electricity to power whole towns, at a price that is competitive with both coal and natural gas. The wind “profile” of the United States is especially promising, with the potential to provide 20% of the nation's energy needs.²⁷ Wind energy is the fastest-growing form of electricity generation in the world, expanding by 30% to 40% annually.²⁸ According to the American Wind Energy Association, the states with greatest wind energy potential include Texas, North and South Dakota, and Kansas. Currently, Texas leads in terms of installed wind power capacity, with California having the second highest capacity.²⁹ The Renewable Energy Policy Project calculates that for every 1000 MW of wind power developed, there is a potential for 3,000 jobs in manufacturing, 700 jobs in installation, and 600 in operations and maintenance.³⁰

The industry employs both professional and skilled workers. According to the Greener Pathways report, these jobs are in wind power installation (construction and transportation), wind farm maintenance and operations, and, most of all, wind turbine manufacturing. Many of the jobs in wind turbine production are similar to traditional manufacturing jobs,⁵ as the following chart highlights.

Typical Employee Profile of a 250-Person Wind Manufacturing Firm (Selected Occupations)

| Occupation | Employees | Earnings |
|---|-----------|----------|
| Engine and Other Machine Assemblers | 31 | 36,300 |
| Machinists | 27 | 40,500 |
| Team Assemblers | 16 | 30,100 |
| Computer-Controlled Machine Tool Operators | 12 | 40,600 |
| Mechanical Engineers | 10 | 71,600 |
| First-Line Supervisors/Managers of Production | 10 | 59,600 |
| Inspectors, Testers, Sorters and Samplers | 8 | 40,400 |
| Lathe and Turning Machine Tool Operators | 6 | 40,000 |
| Drilling and Boring Machine Tool Operators | 4 | 39,800 |
| Welders, Cutters, Solderers and Brazers | 4 | 39,900 |
| Laborers and Freight, Stock and Material Movers | 4 | 29,800 |
| Maintenance and Repair Workers | 4 | 44,100 |
| Tool and Die Makers | 4 | 43,600 |
| Grinding/Polishing/Buffing Machine Tool Operators | 4 | 34,800 |
| Multiple Machine Tool Operators | 4 | 40,800 |
| Industrial Engineers | 3 | 70,400 |
| Industrial Machinery Mechanics | 3 | 46,000 |
| Purchasing Agents | 3 | 56,200 |
| Engineering Managers | 3 | 108,300 |
| Shipping, Receiving and Traffic Clerks | 3 | 32,100 |
| Accountants and Auditors | 2 | 59,800 |
| Executive Secretaries and Administrative Assistants | 2 | 43,200 |
| Electricians | 2 | 49,600 |
| Mechanical Engineering Technicians | 2 | 50,900 |
| Janitors and Cleaners | 2 | 29,800 |

Source: Management Information Services Inc., & American Solar Energy Society, 2007



Geothermal

Geothermal energy, which is generated from the Earth's heat, is poised for growth and job creation. Geothermal resources range from shallow ground to hot water and rock several miles below the Earth's surface, and even farther down to the extremely hot molten rock called magma. Wells that are one mile or more deep can be drilled into underground reservoirs that tap steam and very hot water, which can be brought to the surface and used in a variety of applications. Most geothermal reservoirs are located in the western states, Alaska, and Hawaii.³¹ The Geothermal Energy Association estimates that 2.8 million people in the U.S. get their household energy from geothermal technology.³²

According to a study by the Geothermal Energy Association, the total number of jobs supported by the industry in 2004 was 11,460. This includes direct, indirect and induced employment.³³ Employment figures are expected to increase as the infrastructure is put into place. Jobs include: welders; mechanics; pipe fitters; plumbers; machinists; electricians; carpenters; construction and drilling equipment operators and excavators; surveyors; architects and designers; geologists; hydrologists; electrical, mechanical, and structural engineers; HVAC technicians; food processing specialists; aquaculture and horticulture specialists; resort managers and spa developers.³⁴

Alternative Fuels and Transportation

Biofuels

Bioenergy technologies use renewable plant- and animal-based materials to create liquid fuel (e.g., ethanol and biodiesel), solid fuel (e.g., wood, plant pellets), and many other energy



products. Because biomass conversion works best when the fuel source is located near a generator or refinery, bioenergy creates direct and indirect jobs in rural areas of the country, and may prove to be a profitable complement for many existing agricultural and forestry businesses. While the majority of biomass today comes from the Midwest, crop production for fuel use is likely to be more widely distributed in the future.

Bioenergy ranks second to hydropower in renewable energy production and provides about three percent of the primary energy production in the U.S.³⁵ Currently, the ethanol industry employs an estimated 238,000 people in all sectors, from farming to biofuels plant construction and operation.³⁶ Many biofuel refinery jobs are similar to traditional chemical manufacturing jobs. With the U.S. required to use 36 billion gallons of renewable fuels by 2022, as mandated by the Renewable Fuels Standards established in the Energy Independence and Security Act of 2007, the potential for job creation will be considerable.³⁷



SPOTLIGHT ON JOBS IN BIOFUELS^{5, 18}

Ethanol Plant and System Operator
Ethanol Plant Technician
Chemical Equipment Operator
Electrical & Electronic Maintenance Mechanic
Biodiesel Laboratory Technician



Examples of Educating and Preparing a Green Workforce

Although the shift to clean energy and energy efficiency is still a work in progress, community colleges are already serving as a training ground for green jobs, giving rise to a variety of new or adapted education/training options ranging from associate degree and certificate programs to apprenticeships, Career and Technical Education programs, service-learning projects, and non-credit courses. The following are examples of these activities:

> **Red Rocks Community College, Lakewood, Colorado:** Red Rocks Community College's new A.A.S. degree program in renewable energy technology combines elements of existing HVAC, carpentry, and construction technology programs with courses in energy system design, energy audit techniques, and solar panel installation. For more information, contact: Larry Snyder, Program Coordinator for Renewable Energy Technology at (303) 914-6306 or larry.snyder@rrcc.edu.

> **Santa Fe Community College, Santa Fe, New Mexico:** Santa Fe Community College's Sustainable Technology Center offers non-credit courses and green job training programs. Credit programs include an A.A.S. degree in environmental technologies with concentrations in water conservation or solar energy, and certificates in environmental technologies, green building systems, and solar energy. For more information, contact: Lou Schreiber, Director of Workforce Development at (505) 428-1617 or lschreiber@sfccnm.edu.

> **Great Basin College, Elko, Nevada:** A new distance-learning A.A.S. degree program in industrial energy efficiency – developed in partnership with three other community colleges – combines courses from existing HVAC, construction technology, and electrical systems and millwright technology programs. For more information, contact: Bret Murphy, Dean of Career and Technical Education at (775) 753-2217 or bretm@gwmail.gbcnv.edu.

> **Hudson Valley Community College, Troy, New York:** Hudson Valley Community College's Workforce Development Institute (WDI) includes the Center for Energy Efficiency & Building Science, which provides ongoing training on the incorporation of energy efficiency methods into building trades. The college has established eight additional training sites for this program and several more sites are planned. In addition, the WDI offers a 40-hour photovoltaic electric systems introductory credit-free course designed for individuals who are interested in learning the fundamentals of photovoltaic system design and installation. For more information, contact: Marlene LaTerra, Coordinator, Workforce Development Institute at (518) 629-4835 or m.lattera@hvcc.edu.

> **Cuyahoga Community College, Cleveland, Ohio:** The Green Academy and Center for Sustainability at Cuyahoga Community College trains individuals in the principles of sustainability, green construction, green interior design, green business development, certified photovoltaic installation, business start-up, green/energy auditing, and sustainable facilities management. The Center is dedicated to the understanding and application of green and sustainability concepts. For more information, contact: Leo Russo, Executive Director of the Green Academy and Center for Sustainability at (216) 987-3075 or Leo.Russo@tri-c.edu.

> **Central Carolina Community College, Pittsboro, North Carolina:** Central Carolina Community College offers its students a focus on sustainable fuel production. In the fall of 2008, the college's Pittsboro campus began offering an associate degree in alternative energy technology, which uses the college's comprehensive biofuels testing and production lab to educate students in a variety of industry skills. With support from the North Carolina Biofuels Center, the college is currently constructing a pilot scale plant that is capable of producing both biodiesel and ethanol from various feedstocks. The plant will be designed to produce fuel in a variety of ways to suit training needs. The production facility will also include an oilseed crushing facility and side stream management equipment. The fuel produced in the lab will run college vehicles and equipment. For more information, contact: Andrew McMahan, Program Coordinator at (919) 542-6495, x 214 or amcmahan@cccc.edu.

> **Cape Cod Community College, West Barnstable, Massachusetts:** Cape Cod's environmental technology A.A.S. degree program includes electives in solar and wind energy, energy efficiency, and energy auditing. The college also offers short-term certificate programs in photovoltaic and solar thermal installation, wind turbine installation, and energy conservation. For more information, contact: Stephanie Brady, Environmental Technology Program Coordinator at (508)362-2131, x 4468 or sbrady@capecod.edu.

> **Iowa Lakes Community College, Northeastern Iowa:** Iowa Lakes Community College offers an A.A.S. Degree program that focuses on the operation and maintenance of wind turbines and includes a summer internship between the first and second year of training, as well as a one-year diploma program option. The college currently owns and operates a V-82 turbine and has a V-90 prototype nacelle that students use as an educational laboratory. The Wind Energy and Turbine Technology Program's curriculum is industry-driven, with a program advisory committee as an integral part of the education. Representatives from business serve as guest speakers, provide industry input on curriculum and faculty development, and sponsor field trips to manufacturing and service facilities in the area. For more information, contact: Angie DeJong, Office Associate for Wind Energy at (712) 362-7931 or adejong@iowalakes.edu.



Lansing Community College

LANSING, MICHIGAN

Lansing Community College (LCC), is one of the first colleges in the nation to incorporate alternative energy into its curricula and its sustainability practices on campus. In 2004, the U.S. Department of Energy awarded LCC \$1 million for its alternative energy initiative. Today, LCC instructors help other colleges

and universities across the country create their own alternative energy curricula. LCC's automotive technology students work on hybrid vehicles and are building an internal combustion engine powered by a fuel cell. The college's HVAC and building construction students learn energy management and alternative methods for heating and cooling buildings and residences. Students learn all of this first-hand at LCC's West Campus, heated and cooled by a geothermal system, which is seeking LEED certification from the U.S. Green Building Council. The college has also installed a small solar array and wind turbine on campus.

LCC also offers courses on Principles of Alternative and Renewable Energies; Solar Energy technologies; Bioenergy Technology; Geothermal Technology; Residential Energy; Fuel Cell and Hydrogen Technologies; Wind Energies; Alternative Energy Analysis; and Codes, Regulations, and Standards.

Among the degrees and certificates offered by LCC are A.A.S. degrees in alternative-energy technology and energy specialist, and certificates of achievement in customer energy and stationary energy technology. An Alternative Energy Engineering Technology (AEET) certificate of completion and four new certificates of achievement for students who want to become a windturbine technician, solar technician, geothermal technician, or energy efficiency technician will be available in 2009.

LCC students learn in two state-of-the-art classrooms devoted to alternative energy and receive hands-on experience with commercial alternative energy systems equipment taught by highly-skilled faculty with practical experience in their fields. Students are also given the opportunity to work with sophisticated high-power hydrogen fuel cell systems with computer-aided diagnostics and receive advising and job placement assistance. LCC-educated alternative energy technologists are finding employment with public utilities, alternative energy systems manufacturers, architectural and engineering consulting firms, energy management companies, heating and cooling contractors, and specialty independent energy systems retailers.



For more information, contact: David Wilson, Lead Faculty/Program Coordinator for the Alternative Energy Engineering Technology Program, (517) 483-1104, wilso23@lcc.edu.

Examples of Community College Collaborations

Individual institutions, such as those highlighted, can provide valuable resources. So, too, can collaborations between institutions and industry partners to create successful energy-focused workforce development programs.

The New Energy Workforce (NEW) Initiative is a consortium of San Francisco Bay Region community colleges working together to respond strategically to industry's current and emerging energy workforce needs. **Mission College's** Silicon Valley Workplace Learning Resource Center was instrumental in creating the NEW Initiative and continues to play a critical role in ensuring cooperation among community colleges and increasing their ability to effectively respond to the current trends in clean and green technology. **Cabrillo College** received funding to provide coordination and the Initiative has an array of activities currently underway, as highlighted below.

> **Cabrillo College** is offering courses on solar photovoltaic design and installation and the fundamentals of renewable energy systems. **De Anza College's** Center for Applied Competitive Technologies is overseeing a Silicon Valley Solar Industry-Driven Regional Collaborative (IDRC) grant to train students in the installation of solar photovoltaic panels. A partner in the IDRC grant, **San Jose City College**, will offer a certificate program in energy management and new courses in green construction and photovoltaic installation technology to prepare students for entry-level jobs.

> **Skyline College** is also offering courses and programs in photovoltaic systems, including classes to incumbent workers at local solar companies. In partnership with these companies, the college will also begin offering PV installer classes for those outside the industry and in related trades. **Chabot College**, along with several partners, has implemented field training on the installation and maintenance of solar energy panels and power systems. **Diablo Valley College** submitted a photovoltaic systems design and installation program for regional and state approval and recently hosted a "Train-the-Trainer" PV Design and Installation course for 26 California community college instructors to learn how to replicate the college's model.

The Centers of Excellence & Advanced Transportation Technology and Energy (ATTE) Initiative at **City College of San Francisco** and **West Valley College** conducted a Bay Region Solar Industry Workforce Study. The study identified solar firms in the Bay Area including their

geographical concentration, size, and major sectors; key solar occupations that are most relevant to community colleges; and employer challenges in recruiting, hiring, and retaining their workforce and future employment growth projections. In addition to the study in the ATTE Initiative, the **City College of San Francisco** is developing a full hybrid auto technician maintenance and repair course, and **West Valley College** is working with partners to develop 16 short courses in a heavy wind generation technician certificate program; offering customized training in compressed natural gas courses; and completing training assessments for hybrid technicians, solar installers, and biodiesel production technicians among others.

> **Napa Valley College** has developed an energy and sustainability course in general education and is developing an environmental and energy conservation technology certificate program. **Laney College**'s environmental control technology program prepares students in residential, light commercial, and commercial HVAC and refrigeration, with emphasis on building performance and energy efficiency. Laney recently received an IDRC grant to develop a certificate for control technicians, with emphasis on energy efficiency and whole building performance. **Peralta Community College District** has formed a Green Technology Cluster Group to work with the industry to develop a Green Academy.

For more information about the *NEW Initiative*, visit:

www.newenergyworkforce.com or contact: Kitty O'Doherty, Cabrillo College at (650) 560-9798 or kitodoherty@gmail.com.

> **Consortium for Education in Renewable Energy Technology (CERET)** based at **Wisconsin's Madison Area Technical College** is a National Science Foundation-funded collaborative to increase the number and expertise of renewable energy educators and students at two-year colleges and secondary schools. It offers a certificate model of online and face-to-face courses on renewable energy, which are taught by industry veterans. CERET partners include Oakland Community College, Solar Energy International, the Midwest Renewable Energy Association, and its host institution Madison Area Technical College. For more information, contact: Barbara Anderegg, Principal Investigator, Madison Area Technical College at (608) 246-6812 or banderegg@matcmadison.edu, or visit the Web site at www.ceret.us.



The success of community colleges in the green economy will be built on strategic regional partnerships that include industry, the workforce investment system, industry

associations, unions, economic development organizations, K-12 education systems, universities, and community-based organizations. These partnerships will allow community college leaders to contribute to the green economic and workforce development strategy and vision of the region, leverage and align public and private funding sources, build on existing infrastructures and resources, and work with state, local, and national policymakers and leaders to create policies that support a sustainable, low-carbon economy. In doing so, community colleges will be considered the gateway for the promise of economic opportunity and prosperity in a sustainable world.

Six Action Steps for Community College Leaders to Build a Sustainable Future

The following action steps will help community colleges play a critical and leading role in creating a sustainable future and green workforce.

1

Serve as the catalyst in your community or region for educating diverse audiences about environmental stewardship, sustainable development, and the green workforce - its expanding size, capacity, and versatility.

2

Reduce your institution's carbon footprint. Appoint a task force or coordinating committee to conduct a comprehensive greenhouse-gas emissions inventory, identify efficiency problems, and develop strategies for addressing them.

3

Make sustainability a defining feature of campus culture and a guiding principle for management, planning, resource allocation, programming, research, and professional development.



4

Pursue strategic partnerships with businesses, industry associations, governments, other community colleges and universities, the K-12 education and workforce investment systems, nonprofit organizations, unions, and other key stakeholders. Use these partnerships to update and redesign curricula, create new degrees and certifications, gain access to accurate labor market information, and develop new pathways to employment and advancement in green high-demand, high-growth industries.

5

Join forces with leading green community colleges or existing regional/national collaboratives to avoid reinventing the wheel. Draw on their expertise and experiences and access their resources on best practices and strategies, innovative teaching methods and curricula, technical support, and networking opportunities.

6

Tell your story on campus, in the community, and in the media. Promote your college's sustainability initiatives and green workforce development programs to help generate enthusiasm and support among students, faculty, staff, alumni, policymakers, the community, and potential funders.

Appendices



Appendix A: Web Sites on Climate Change and Promoting Sustainability

American College Personnel Association (ACPA)

ACPA is an international association of student affairs professionals and one of the founding organizations of the Higher Education Associations Sustainability Consortium (HEASC). ACPA's Task Force on Sustainability provides resources for college educators to develop and expand sustainable programs and efforts on their campuses.

www.myacpa.org/task-force/sustainability

American Council for an Energy-Efficient Economy (ACEEE)

This national organization provides economic data, research findings, and policy recommendations on energy efficiency, renewable energy, climate change, and environmental issues.

www.aceee.org

American Public Power Association (APPA)

APPA offers a summary of Clean Renewable Energy Bonds (CREBs), a financing mechanism available through the Internal Revenue Service for public-sector renewable energy installations.

www.appanet.org/files/PDFs/CREB.pdf

Apollo Alliance

The Apollo Alliance is a coalition of business, labor, environmental, and community leaders working to catalyze a clean energy revolution in America to reduce the nation's dependence on foreign oil, cut the carbon emissions that are destabilizing our climate, and expand opportunities for American businesses and workers.

www.apolloalliance.org



Association for the Advancement of Sustainability in Higher Education (AASHE)

AASHE serves colleges and universities in the United States and Canada and provides information and resources for postsecondary institutions working to craft and advance a strategic agenda for campus sustainability.

www.aashe.org/about/programs.php

Center for American Progress (CAP)

Center for American Progress is a think tank dedicated to improving the lives of Americans through ideas and actions. CAP's policy experts cover a range of issue areas and often work across disciplines to tackle complex, interrelated issues such as national security, energy, and climate change.

www.americanprogress.org

Center on Wisconsin Strategy (COWS)

COWS is a national policy center and field laboratory for high-road economic development — a competitive market economy of shared prosperity, environmental sustainability, and capable democratic government.

www.cows.org

Clean Air-Cool Planet (CA-CP)

CA-CP works with campuses, businesses, communities, and government agencies in the northeastern United States to develop and implement solutions to global warming. Among its resources is a Campus Carbon Calculator to help colleges and universities perform an inventory of greenhouse gas emissions.

www.cleanair-coolplanet.org

Database of State Incentives for Renewables and Efficiency (DSIRE)

DSIRE provides comprehensive information on renewable energy and energy-efficiency incentives available through federal, state and local governments, and public utilities.

www.dsireusa.org

Disciplinary Associations Network for Sustainability (DANS)

DANS is an informal network of professional associations in 20 disciplines, ranging from biology, chemistry, and engineering to anthropology, political science, and journalism that focuses on: (1) infusing sustainability into curriculum, standards, tenure requirements, and accreditation criteria; and (2) educating the public on sustainability.

www.aashe.org/dans/

Energy Action Coalition

Founded in June 2004 by youth climate leaders, the Energy Action Coalition unites a diversity of organizations in an alliance that supports and strengthens the student and youth clean energy movement in North America.

www.energyactioncoalition.org

Green Restaurant Association

This nonprofit organization has developed a comprehensive database of environmentally responsible products for the food service industry.

www.dinegreen.com

Higher Education Association's Sustainability Consortium (HEASC)

HEASC is an informal network of higher education associations formed to advance sustainability among their membership and on college and university campuses.

www.aashe.org/heasc

National Wildlife Federation

National Wildlife Federation's Campus Ecology program promotes climate leadership and sustainability among colleges and universities by providing resources and technical support, creating networking opportunities, and organizing education events.

www.nwf.org/campusecology

Pew Center on Global Climate Change

The Pew Center on Global Climate Change brings together business leaders, policymakers, scientists, and other experts to bring a new approach to a complex and often controversial issue. Pew's approach is based on sound science, straight talk, and a belief that we can work together to protect the climate while sustaining economic growth.

www.pewclimate.org

RecycleMania

RecycleMania is a friendly competition and benchmarking tool for college and university recycling programs to promote waste-reduction activities in their campus communities. RecycleMania is supported by the U.S. Environmental Protection Agency's WasteWise program and the National Recycling Coalition.

www.recyclemaniacs.org

Second Nature

Second Nature is a nonprofit organization dedicated to promoting and supporting sustainability education at colleges and universities.

www.secondnature.org

U.S. Green Building Council (USGBC)

The USGBC has developed the Leadership in Energy and Environmental Design (LEED) Green Building Rating System, a third-party certification program and nationally accepted benchmark for the design, construction, and operation of high-performance green buildings.

www.usgbc.org

U.S. Partnership for Education for Sustainable Development

This partnership of individuals, organizations, and institutions is dedicated to promoting the integration of sustainable development into education, training, and learning.

www.uspartnership.org/main/view_archive/1



Appendix B: Web Sites on Educating and Preparing a Green Workforce

Advanced Technology Environmental and Energy Center (ATEEC)

ATEEC, which is funded by the National Science Foundation and sponsored by the Eastern Iowa Community College District, was created to help two-year colleges share information, ideas, and best practices in environmental and energy technology education.

www.ateec.org

Association of Energy Engineers (AEE)

AEE is a nonprofit professional society whose mission is to promote the scientific and educational interests of those engaged in the energy industry and to foster action for sustainable development. AEE provides industry standards for training and certification in such areas as energy management and lighting efficiency.

www.aeecenter.org

ATTRA - National Sustainable Agriculture Information Service

ATTRA provides information on sustainable agriculture and organic farming news, events, programs, and funding, and links to sustainable agriculture education programs at two- and four-year colleges.

www.attra.ncat.org

Business Council for Sustainable Energy (BCSE)

BCSE was created in 1992 by leaders from the energy efficiency, renewable energy, natural gas, independent power, and electric utility industries to promote economic growth through sustainable energy development.

www.bcse.org

Interstate Renewable Energy Council (IREC)

IREC is a nonprofit organization dedicated to expanding the adoption and use of renewable energy sources and technologies. Its workforce development initiatives include efforts to create competency and certification standards for renewable energy professionals and training programs.

www.irecusa.org

Green for All

Green For All is a national organization dedicated to building an inclusive green economy strong enough to lift people out of poverty. Green for All advocates for local, state, and federal commitment to job creation, job training, and entrepreneurial opportunities in the emerging green economy – especially for people from disadvantaged communities – to fight both poverty and pollution.

www.greenforall.org

Partnership for Environmental Technology Education (PETE)

PETE's mission is to provide leadership in environmental technology training and education at community and technical colleges. It offers model curricula and other instructional resources.

www.ateec.org/pete

Skills USA

Skills USA is a national partnership that has developed programs for high school and college students preparing for careers in the skilled trades and technical fields.

www.skillsusa.org

The Blue Green Alliance

Launched in 2006, the Blue Green Alliance is a strategic initiative led by the United Steelworkers and partners. The alliance focuses on three key issues: global warming and clean energy; fair trade; and reducing toxics.

www.bluegreenalliance.org

The Corps Network

The Corps Network is the voice of the nation's 136 Service and Conservation Corps. Currently operating in 42 states and the District of Columbia, the Corps annually enrolls more than 26,000 young men and women in service. Service and Conservation Corps provide a wealth of conservation, infrastructure improvement, and human service projects.

www.corpsnetwork.org

FEDERAL GOVERNMENT FUNDING WEBSITES

The following federal agencies provide resources and support for community colleges seeking to expand and diversify education and training programs related to clean energy technologies, environmental science, and sustainable development.

Environmental Protection Agency

Brownfields Job Training

www.epa.gov/brownfields/job.htm

Community Action for a Renewed Environment (CARE)

www.epa.gov/care

Environmental Education Division (EED), Office of Children's Health Protection and Environmental Education

www.epa.gov/enviroed/grants.html

Grants & Fellowships

www.epa.gov/ogd/grants/information.htm

National Clean Diesel Campaign

www.epa.gov/otaq/diesel/grantfund.htm

Pollution Prevention Grants

www.epa.gov/oppt/p2home/pubs/grants/ppis/ppis.htm

Sustainable Skylines Initiative

www.epa.gov/sustainableskylines

National Aeronautics and Space Administration

Office of Education, Programs Integration Division

www.nspires.nasaprs.com

National Oceanic and Atmospheric Administration

Climate Program Office

www.climate.noaa.gov

National Science Foundation

Advanced Technology Education (ATE) Program

www.nsf.gov/pubs/2007/nsf07530/nsf07530.htm

Course, Curriculum, and Laboratory Improvement (CCLI) Program

www.nsf.gov/funding/pgm_summ.jsp?pims_id=5741&org=DUE&from=home

United States Department of Agriculture

Energy Programs

www.usda.gov/rus/index2/0208/EnergyPrograms.htm

United States Department of Housing and Urban Development

Neighborhood Stabilization Program Grants

www.hud.gov/offices/cpd/communitydevelopment/programs/neighborhoodspg

United States Department of Energy

Office of Energy Efficiency and Renewable Energy (EERE)

www.eere.energy.gov

National Laboratories and Technology Centers

www.energy.gov/organization/labs-techcenters.html

United States Department of Labor

Community-Based Job Training Grants

www.doleta.gov/sga/sga/SGA_07-01_Comm-Based.pdf

High Growth Job Training Initiative

www.doleta.gov/BRG/JobTrainInitiative

Workforce Innovation in Regional Economic Development (WIRED) Initiative

www.doleta.gov/wired/about/faqs.cfm#2

Youthbuild

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