A report from Regional Energy Conversations sponsored by the Advanced Technological Education Program of the National Science Foundation and by the Advanced Technology Environmental and Energy Center

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• Eastern Iowa Community College District

• Partnership for Environmental Technology Education

• University of Northern Iowa

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INTRODUCTION

The energy technology industry is growing by leaps and bounds. The advent of new technologies, public interest in “green” jobs, the increased role of energy in national security issues, changes in regulatory compliance requirements, and the changing demands of industry call for a realignment of academia, industry, business, and government stakeholders. New energy technology career categories are emerging at an unprecedented pace, and skill sets traditionally associated with energy technology are cutting across both traditional and emerging industries.

In 2008, the Advanced Technology Environmental and Energy Center (ATEEC) published the national Defining Energy Technologies and Services report. This report, funded by the National Science Foundation (NSF), contains the results of a national forum for defining energy technology. The report provides an overview of the energy field in the U.S., including:

- Title and definition of the field of energy technology
- Definition of technician
- Energy technology occupational categories
- Technician-level occupational titles
- Job functions typically performed in each occupational category

Committed to promoting collaboration and flexibility among energy stakeholders in order to meet the needs of the U.S. workforce, NSF decided in 2009 to take a second important step in beginning to effectively and efficiently address the rapid changes in the energy field and the resulting need for worker training. Pragmatically, there is a growing need to ensure that the rush to train energy technology workers is balanced by a systematic analysis of what jobs are needed and where those jobs are located. The workforce cannot be well served by providing training to technicians without corresponding jobs in the labor market.

To this end, NSF tasked ATEEC with facilitating a series of seven regional Energy Conversations. The primary purpose of the conversations has been to obtain a snapshot view of existing and upcoming energy jobs and to determine which jobs are currently needed in different regions of the country. The resulting report on these Energy Conversations is intended to provide a preliminary labor market analysis and needs assessment. This information allows educational organizations to most effectively target regional energy industry requirements and to provide both short- and long-term education and training for the energy technicians of the 21st century workforce.

Energy Technologies and Services is a career field that applies the principles of science, engineering, communication, economics, management, and law to optimize the sustainable production, delivery, and use of energy resources.

The audience for this report includes:

- Counselors, faculty, and administrators of academic institutions at all levels, but particularly in two-year colleges and high schools
- Technicians and employers of technicians (e.g., companies, government agencies);
- Leaders of professional societies
- Federal, state, and local government officials responsible for the quality and quantity of the nation’s technical workforce

Ultimately, this report should contribute to addressing the workforce development needs of business, industry, and government by providing educators with information needed to develop relevant curriculum that prepares students for energy technology careers. The report will also be used to provide direction for ATEEC, a Center of Excellence partially funded through a grant from NSF. The Center brings together educational institutions, training organizations, business, and industry stakeholders from across the nation to promote and assist in developing relevant and high-quality energy technology programs.
ATEEC collaborated with NSF to choose seven representative regions in the country in which to hold each one-day Regional Energy Conversation meeting. ATEEC coordinated the effort with regional host organizations, which invited experienced energy technology practitioners and educators in the region who have a broad perspective of the various occupational areas included in this field. The participants who attended the Energy Conversations included business, industry, non-profit, and government agency representatives, as well as two- and four-year college environmental technology educators. The coordinators attempted to gather a broad representation of participants from each region as possible within limited time and budget constraints.

Using the national *Defining Energy Technologies and Services* report as a point of reference, the 2009/2010 Regional Energy Conversation participants agreed to use the following general assumptions for the purposes of their discussion, in order to make the most efficient use of their expertise in targeting specific energy occupations:

- Energy technologies and services is a career field that applies the principles of science, engineering, communication, economics, management, and law to optimize the sustainable production, delivery, and use of energy resources.
- The definition of a technician is a worker who applies knowledge, skills, and abilities to perform scientific, technical, communication, and regulatory tasks.
- The educational background for technicians typically ranges from a high school diploma plus on-the-job training to a two-year associate degree, usually in an applied technology program.

In each energy conversation, ATEEC facilitators assisted participants working in large and small discussion groups to address the following items at a regional level:

- Specific technician-level jobs typically found in the area
- Types of certification required by these jobs
- Labor market data resources for the region
- Most prevalent and fastest-growing jobs
- Area’s current Best Practices in education and training for energy jobs
- Common technical skills that cut across energy occupations
- Common employability skills required for most of these occupations
- Future trends in the energy field

The results of the input gathered from the energy field experts across the country are contained in this report. The following sections are presented by region and detail the area’s current occupations, labor market data, and model programs and partnerships in energy technology education. Highlighted job titles indicate regional differences between regional and national occupational titles. (National job titles are based on those listed in the *Defining Energy Technologies and Services* report.)
SOME COMMONALITIES AMONG REGIONS

- Energy auditing is consistently the highest rated occupation in all regions. All representatives from utility companies agreed that the next five to ten years will see a significant and critical increase in the need for utility workers. This is due to several factors, primarily the beginning of the retirement of much of the current workforce.

- The fastest-growing occupations that will need to be addressed by the education and training community fall into the categories of:
  
  o Energy efficiency, including building design/construction, facilities operation and maintenance, and energy assessment.
    
    - Need energy auditors to find inefficiencies
    - Need system verification technicians (third party to verify efficiencies)
    - Knowledge of LEED important
    - Once buildings are efficient, will need building operators to maximize efficiencies
  
  o Renewable energy, particularly wind, solar photovoltaic, and solar thermal
    
    - Need knowledgeable installers and maintenance technicians to ensure that the renewable energy systems work effectively for the long-term (lack of this was a major reason for public abandonment of renewable energy in the 1980s)
    - Need both large- and small-scale systems technicians

- Most of the occupations in the energy field are not new jobs; they are “increased demand” (e.g., utility workers) or “enhanced skills” (e.g., wind turbine technicians) occupations. (See page 6 for a good description of these distinctions from the U.S. Department of Labor.) The implication for education and training is that most curricula developed for the energy field will entail integrating minor new skills into an existing program or using an existing program as a base upon which to build new and/or enhanced energy skills.

- When developing any new energy program, it is critical that the first step is a credible labor market assessment to ensure that education aligns with available and upcoming jobs.

- With the rapid changes in technology in the energy sector, educators must maintain regular, periodic interaction with business and industry (e.g., advisory committees, occupational analyses) to ensure that skills being taught align with the skills needed in the workplace.

- Business and industry representatives noted an increasing importance for short-term credit and noncredit certificates that emphasize skills.

- Core foundational courses and programs are needed that can be transferred to a variety of energy careers.

- Local and state energy incentives do much to determine the regional demand for different types of workers.
Snapshot of Some Regional Emphases in Energy

• Alternative Fuel Vehicle (AFV): Northwest, Southeast, and Southwest
• Building trade workers: Mid-Atlantic and North Central
• Geothermal: North Central and South Central
• Large-scale solar: Southeast and Southwest
• Large-scale wind: North Central, South Central, and Southwest
• Nuclear: Mid-Atlantic
• Ocean energy: Northwest and South Central
• Oil and gas: South Central and West
• Small-scale solar and wind: North Central and Southeast
• Solar and wind equipment manufacturing: West
• Utility and smart-grid workers: Northwest and Southeast
Green Jobs Analysis

While written to address the overall area of green jobs rather than targeted specifically to the energy sector, the following excerpts from a report (Greening of the World of Work: Implications for O*NET®-SOC and New and Emerging Occupations) from O*NET at the U.S. Department of Labor provide a description of occupational analysis pertinent to jobs in the energy field and accurately capture a major theme from the Regional Energy Conversations:

To summarize, there are two primary implications for occupational analysis in general […]. First, the vast job-level information in the existing green economy literature must be consolidated and interpreted for its meaning at the occupation level. In particular, a focus on occupational requirements (tasks, duties, tools and technology, knowledge, skills, and so forth) is essential for discovering the occupational implications of the green economy.

Second, any analytical or descriptive approach used to determine the occupational implications of the green economy must be sensitive to the varying degrees with which green economy activities shape occupational performance. This entails a definitional approach to “green occupations” that moves beyond labeling (i.e., green as adjective) to encompass the dynamic nature of occupational performance (i.e., greening as verb). A parallel can be seen in the shift away from an emphasis on “organization” to “organizing” in the general management literature in order to address the effects of contextual changes in the 1990s (e.g., flattening of firms, use of teams, project-based work).

This definition lends itself to three general categories, each describing the differential consequences of green economy activities and technologies on occupational performance. These categories of occupations are described below and include examples of the effects indicative of each. […]

Green Increased Demand Occupations. The impact of green economy activities and technologies is an increase in the employment demand for an existing occupation. However, this impact does not entail significant changes in the work and worker requirements of the occupation. The work context may change, but the tasks themselves do not. An example is the increased demand for electrical power line installers and repairers related to energy efficiency and infrastructure upgrades.

Green Enhanced Skills Occupations. The impact of green economy activities and technologies results in a significant change to the work and worker requirements of the occupation. However, this impact does not entail significant changes in the work and worker requirements of the occupation. The work context may change, but the tasks themselves do not. An example is the occupation architect, where greening has increased knowledge requirements pertaining to energy efficient materials and construction, as well as skills associated with integrating green technology into the aesthetic design of buildings. For example, many architects have pursued Leadership in Energy and Environmental Design (LEED) certifications to ensure the proper application of U.S. Green Building Council principles to building designs. The essential purposes of the occupation remain the same, but tasks, skills, knowledge, and external elements, such as credentials, have been altered.
New and Emerging (N&E) Green Occupations. The impact of green economy activities and technologies is sufficient to create the need for unique work and worker requirements, resulting in the generation of a new occupation. This new occupation could be entirely novel or “born” from an existing occupation. An example would be solar system technicians who must be able not only to install new technology, but also to determine how this technology can best be used on a specific site.

Acknowledgement

Participants expressly asked ATEEC to include in this report their thanks to the National Science Foundation for providing this opportunity for the diverse sets of energy stakeholders to gather and share their needs and knowledge. They hope that conversations such as these can continue to be promoted by government entities to help integrate the requirements of business and industry with the education and training needed by technicians of the U.S. workforce to enhance the economy by successfully keeping pace with a rapidly changing industry and world.
Northwest
- Renewable energy systems installer
- Energy auditing technician (residential)
- Maintenance technician
- Utilities technician
- Manufacturing technician

Southwest
- Alternative Fuel Vehicle (AFV) repair/maintenance technician
- Energy auditor
- Renewable energy systems installer
- Solar photovoltaic technician
- Electrical controls technician

West
- Energy auditor
- Building analyst
- Solar/wind manufacturing production technician
- Wind turbine mechanic
- Power quality engineer

Fastest-Growing Energy Jobs

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MID-ATLANTIC ENERGY CONVERSATION

JOB CATEGORIES AND TITLES

Note: Highlighted text in this section indicates a regional difference in the job title from the national job titles. It may indicate a difference in wording of the job title or a job title specific to a region that was not identified as a national job title. (National job titles are based on those listed in the national report, Defining Energy Technologies and Services (www.ateec.org/store/)).

FASTEST-GROWING JOBS IN THE MID-ATLANTIC

Energy Conversation participants identified the following occupations as high-demand and rapidly growing jobs in their region. The jobs in black were ranked highest.

- Plans, review, and/or building inspector
- Skilled construction workers
- Mechanical maintenance technician
- Plant operator
- Electrical maintenance technician
- Instrumentation control technician
- Project planner/scheduler
- Building energy auditor
- HVAC technician
- Design technician (solar PV)
- Rooftop solar installer
- Welder
- Process equipment energy technician
- Energy evaluator
- Machinist
- Chemistry technician
- Distributed automation technician
- Substation technician
- Electrical system operator
- Recycling plant operator
- Battery technician
Buying & Selling Energy
Energy consultant
Residential customer service tech

Construction/Building Science
Building energy auditor
Crane operator
Facilities operations tech
Green building appraiser
Insulator/air sealer
Journeyman
LEED officer
Permits & license tech
Plans, review, and/or building inspector
Procurement officer
Skilled construction tradesperson
Trades/industry instructor
HVAC tech

Cross-Cutting
Assembler
Bio-security tech
Cost analyst
Customer service tech
Electrician
Energy paralegal
Estimator
Fire protection tech
Foreman/manager
Installation tech
Instructor
Network tech
Non-destructive examination tech
Plant security
Project planner/scheduler
Purchasing & contracts tech
Quality assurance tech
Resource assessment tech
Safety tech
Sales
Site inspector
Site planning tech
Technical writer
Welder

Energy Efficiency
Carbon/greenhouse gas analyst
Energy evaluator
Green roof tech
Process equipment energy tech

Generation
Electrical maintenance tech
Instrumentation control tech

Machinist
Mechanical maintenance tech
Non-licensed operator/auxiliary operator
Pipefitter/pipe layer/boiler maker
Plant operator
Process control operator

Miscellaneous
Biofuel lab tech
Composites tech (wind)
Geothermal tech
Hybrid auto tech
Hydrological site assessor
Landscape tech
Miner
Storage tech
Tidal/currents tech

Nuclear
Chemistry tech
Radiation protection tech

Recycling
Battery tech
Computer/equipment repair tech
Plant operator

Research
Grant writer
Web site designer

Solar PV
Design tech
Rooftop solar installer

Solar Thermal
Plumbing tech
Rooftop solar installer

Sustainability
Agricultural engineering tech
Stormwater management tech

Transmission/Distribution (incl. Smart Grid)
Distribution automation tech
Distributed generation interconnection tech
Electrical system operator
Engineering tech
Industrial mechanic
Line worker
Meter tech
Relay tech
Substation tech
Utility communications tech
MID-ATLANTIC ENERGY CONVERSATION (cont.)

OCCUPATIONAL DATA

Labor Market Data Resources
Annual reports available from each resource
Career Technical Education STEM report
Construction Users Round Table
EPRI & Western Maryland Consortium
EPRI—industry-specific organization
Industry-Wide Technical CEWD Energy Competency Model
Mid-Atlantic—utility profile regionally consistent
National Commission of Energy Policy
South East Manpower Tripartite Alliance—EMTA Data
State energy consortium
U.S. Department of Energy reports
U.S. Department of Labor Bureau of Labor Statistics—forecast of energy jobs
U.S. Department of Labor Governor’s Workshop Investment Board reports

Potential numbers of jobs
• Baltimore Gas & Electric 50-100 gas technician types per year for the next five years (out of a 3,300 employee company)
• CEWD—technician type positions 70,000-80,000
• USA Today (September 25, 2009)—Clean jobs 770,000
• NEI 19,400 +/– in next five years—104 facilities in U.S.
• Anecdotal info:
  o Large manufacturing industry still moving out of MD
  o Follow the money

Best Practices
Anne Arundel Community College—Green Technology Certificate
Association of Energy Engineers (CEM, CEA, Green Building certification)
BGE & PEPCO line training—$250,000/18 months
CEWD partnering access
Fort Ritchey (former army base), COPT—mixed-use ultra green transformation
Gulf Power Academy/High School Career Academy—mentorship program & cooperatives based on apprenticeships
High school career academies
HVAC & CCBC—model best practices
Internal utility training programs
Linn State program
National Clean Energy Center Network—researchers & 14 centers
Online training programs (e.g., Bismarck State)
PG&E partnerships with community colleges—pipeline of interns
Pittsburgh—Economic Development Model
PJM—Training stakeholders/FERC recognized
Pre-apprentice programs—8-10 weeks
Purdue Green Technician certification with Society of Manufacturing Engineers
Southeast Lineman Center
Texas A&M—community college pilot projects/easy handoffs of courses/articulate to 4-year/coordinated with industry
Two-year technician certificates, variety of programs (classroom & OJT)
Job Categories and Titles

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Fastest-Growing Jobs in North Central U.S.

Energy Conversation participants identified the following occupations as high-demand and rapidly growing jobs in their region. The jobs in black were ranked highest.

- HVAC tech
- Wind turbine tech
- Controls tech (industrial)
- Pipefitter
- Hybrid auto tech
- Transportation planner permit specialist
- Maintenance tech (transportation)
- Energy engineering tech (building)
- Building & construction tech
- Building inspector
- Agri-science tech
- Biorefinery tech
- Process tech (biomass)
- Turbine maintenance & repair tech
- Electronic/electrical tech (wind)
- Transmission tech (wind)
- Site assessor (solar)
- Electrician (solar)
- Inspection/tester (solar)
- Electrical engineering tech
- Lineman
- Meter specialist
- Energy manager (industrial)
## Biomass
- Aggregator/broker
- Agri-science tech
- Biorefinery tech
- Biotechnology tech
- Diesel engine repair & maintenance
- Engine assembler
- Farmer
- Forester
- Harvester
- Horticultural specialist
- Instrumentation automation control tech
- Lab tech
- Machine operator (pellet mill)
- Moisture specialist
- Process tech
- Tank inspector/cleaner
- Water/hydro tech

## Building Science
- Architect tech
- Building & construction tech
- Building inspector
- Carbon footprinter
- Carpenter
- Cement masons
- Commissioning agent
- Construction tech
- Energy auditor
- Energy engineering tech
- Energy program manager
- Green roof installer
- Habitat restoration specialist
- Home performance evaluator
- Home weatherization installer/tech
- Insulator
- Landscape site evaluator
- Lead abater
- Operating engineer
- Project management assistant
- Residential energy efficiency consultant
- Residential energy efficiency tech
- Steamfitter

## Energy Efficiency (Industrial/Business)
- Boiler operator
- Compressed air specialist
- Controls tech
- Electromechanical (integration) tech
- Energy manager
- Industrial machinery mechanic
- Lighting tech
- Process maintenance tech
- Refrigeration tech
- Small business direct installer

## Geothermal
- Geology/soil tech
- HVAC tech
- Industrial maintenance tech
- Marketer
- Pipefitter
- Plastic tech
- Plumber
- Well driller

## Miscellaneous
- Accountant
- Computer support specialist
- Data acquisitions tech
- Educator/trainer
- GIS tech
- IT network tech
- Measurement verification tech
- Permitting specialist
- Policy analyst
- Public relations specialist
- Real estate appraiser
- Small hydropower installer

## Solar
- Assembler
- Electrician
- Financial analyst
- Glazier/glass installer
- Inspector/Tester
- Laminator
- Office manager
- Roofer
- Shift manager
- Site assessor
- System installer
Transportation
CAD operator
Fuel analyst
Hybrid auto tech
Logistics tech
Maintenance tech
Surveyor
Transportation planner permit specialist

Utilities
Cartographer
Computerized machinist CNC operator
Dispatcher
Electrical engineering tech
Gas tech
Lineman
Meter specialist

Wind
Cement civil works engineering tech
Crane operator
Turbine maintenance & repair
Electronic/electrical tech
Land agent
Machinist
Meteorological tech
Sheet metal worker
Sound tech
Transmission tech
Welder
Wind turbine tech

Labor Market Data Resources
American Solar Energy Society
Apollo Alliance
American Wind Energy Association
Community college program advisory committees (local)
Center on Wisconsin Strategy (COWS) reports (cows.org)
Energy Information Services
Focus on Energy
IBEW (apprenticeships)
Interstate Renewable Energy Council
Midstate Technical College-Wisconsin Rapids
Midwest Renewable Energy Association
NBB Biodiesel Board
OEI
Professional associations (e.g., architects, engineers, state chapters)
PWD—Projections
Regional partnerships
Renewable Fuels Association
Renew Wisconsin
Rise Project/WIRED
Roger Bezbeck reports
SCIA
Specific company needs
Union of Concerned Scientists
U.S. Green Building Council chapters
Wage and Economic Development Council
WI Regional Training Partnership

Best Practices
Advanced Technology Education community
(National Science Foundation)
Advanced Technology Environmental and Energy Center (ATEEC)
Alliant Partnerships—(pipeline, K-12)
Appalachian State College
Build America—U.S. Department of Energy Career fairs
Clean Energy Corps—President Obama
Energy Academy (high school)—Mid-State
Energy Center of Wisconsin
Equipment manufacture/training
Equipment training
Farm Kids
Florida Solar Energy Center
Great Lakes Renewable Energy
Integrated skills
Internships
Interstate Renewable Energy Council
Lane Community College
LA Trade Tech
Madison Area Technical College/CERET
MidState Renewable Programs
Midwest Renewable Energy Association
Military training
NFPA curriculum/codes
North Carolina State University diploma series
On-the-Job Training (OJT)/job experience
PLTW/Wisconsin Energy Education Program
RESNET
Rise Partnership
Solar Energy International
State agencies (e.g., Department of Natural Resources)
University of Wisconsin Extension Offices
Wisconsin Public Utilities Institute
Wisconsin Energy Conservation Corps
Wisconsin Regional Training Partnership
NORTHWEST ENERGY CONVERSATION

JOB CATEGORIES AND TITLES

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FASTEST-GROWING JOBS IN THE NORTHWEST U.S.

Energy Conversation participants identified the following occupations as high-demand and rapidly growing jobs in their region. The jobs in black were ranked highest.

- Renewable energy systems installer
- Energy auditing tech (residential)
- Maintenance tech
- Utilities tech
- Manufacturing tech
- Alternative Fuel Vehicle (AFV) repair/maintenance tech
- Renewable energy maintenance tech
- Energy efficient construction tradesperson/site foreman
- Renewable energy site assessment tech
- Energy analysis tech
- Energy manager/specialist/consultant
- Energy project developer/manager
- Sustainability coordinator
- Wind turbine tech
- Alternative financing specialist
- Building control systems tech
- Building operator
- Carbon trading analyst
- Commissioning tech
- Electrical energy storage tech
- Ocean power tech*
- Utility-scale renewable energy installation tech

*Emerging
Buying & Selling Energy
Customer service representative (internal)**
Power scheduler
Real-time trader
Sales representative (external, non-utility)

Energy Assessment
Energy analysis tech
Energy auditing tech
Energy portfolio planning tech*
Industrial process tech
Measurement & verification tech*
Renewable energy site assessment tech (residential)*, including geothermal, hydro-

Power scheduler
Real-time trader
Sales representative (external, non-utility)

Energy Efficient Building Construction, Project Engineering, & Implementation
Commissioning tech
- Verify systems operation & interoperations
- Measurement & verification

Energy auditing tech
Energy efficient construction tradesperson/site foreman*
Energy project developer/manager, including scheduler, engineering tech, CAD/CAM tech/ draftsperson, & GIS tech
Interior design tech
Renewable energy systems installer*
Site & building exterior manager, including xeriscaping & shading
Testing/commissioning tech
Water conservation tech

Exploration
Crop yield/biomass analyst (agriculture, aquaculture, & silviculture)
Geology tech
Geospatial tech
Oil & gas exploration tech
Solar resource assessor
Surveyor/site resource assessor
Wind resource assessor

Generation & Utility-Scale Construction
Biofuels processing tech*
Boiler tech
Coal gasification tech
Coal miner
Cogeneration tech
Combustion tech
Energy crop farmers
Energy specialist
Fuel cell tech*

Generator tech
Geothermal tech
Green power tech*
Hydropower tech
Infrastructure/construction tech (installation)
Instrument/control tech & process operator
Nuclear fuel enrichment & reprocessing tech
Nuclear reactor tech
Ocean power tech*
Oil & gas field tech
Oil & shale & tar sand processing tech
Oil refinery/process tech
Solar photovoltaic tech
Solar thermal tech
Utility-scale renewable energy installation tech
Waste-to-energy tech
Wind turbine tech

Operations & Maintenance
Building control operator
Building control systems tech
Building operator
Building systems automation tech*
Direct digital control (DDC) programmer
Energy cost analyst
Energy manager/specialist/consultant
Industrial process equipment maintenance & operations specialist
Lighting specialist
Maintenance tech
Performance monitoring/continuous commissioning tech
Program/project coordinator
Renewable energy maintenance tech
Resource conservation/efficiency manager
Stationary operating engineering tech
Sustainability coordinator*
Waste management/recycling tech

Regulatory Affairs
Code inspector (municipal, county, & state)
Compliance specialist (municipal, county, state, & federal)
Energy regulation specialist
Energy technology program specialist (state & federal)
Fuel testing/verification tech
Incentive auditing (verification)
 Permit specialist
Plan reviewer/checker
Public policy specialist
Surveyor/site assessor

*Emerging **On-the-Job Training (OJT)
TRANSMISSION & DISTRIBUTION

- Distribution tech
- Emergency response
- Environmental safety & health
- Equipment operator/controls operator
- Fuel storage tech
- Infrastructure/construction tech
- Outage reporting
- Utilities tech

TRANSPORTATION (MOBILE) SERVICES

- Alternative fuel vehicle (AFV) repair/maintenance tech
- Emissions testing & repair tech
- Fleet manager
- Transportation, warehousing, & logistics tech
  (geospatial, planning, public transportation, multi-modal transportation, expediting)

LABOR MARKET DATA RESOURCES

- American Wind Energy Association
- “Analysis of Clean Energy Workforce Needs and Programs in Oregon”—3E Strategies
- Center of Excellence for Energy—Centralia Community College, Oregon
- “Employment Department” Web site—State of Oregon
- “Energy Efficiency Study”—Centers of Excellence in California Community Colleges (COECCC)
- Foundation for Water and Energy Education
- “Get Into Energy” training database—Center for Energy Workforce Development (CEWD)
- “Greening of Oregon’s Workforce Jobs, Wages, and Training” report—Worksource Oregon
- Idaho Office of Energy Resources
- Northwest Energy Education Institute
- Northwest Energy Efficiency Alliance
- Northwest Energy Efficiency Council
- Northwest Public Power Association
- Oregon Department of Energy
- Oregon State University Energy Efficiency Center
- Oregon Labor Market Information System
- Trades association statistics (e.g., IBEW)
- Washington State Board for Community and Technical Colleges
- Washington State University, Extension Energy Program
- Washington Work Source

“Workforce Challenges of Electric Sector Employers in Washington and Oregon”—Washington State University, Extension Energy Program
Worksource Oregon

BEST PRACTICES

- Annual review of curriculum relevance
- Bridge programs/pipeline, occupational, contextualized adult basic education/GED
- Career pathways roadmap Web tool
- Co-op programs
- Emphasize the specificity of individual renewable energy areas (community colleges need to educate students, career advisors, guidance counselors, public with career fairs, career videos, etc.)
- Employer advisory boards with each department
- Energy awareness (e.g., behavior changes, social responsibility, sustainability, organizational fit)
- High school exposure by community college & employer panels—bring manufacturing to students
- Industry experts hired as adjunct faculty
- International programs/connections
- Internships for students & teachers
- National certification of programs
- Regional assessments & information-gathering
- Regional Technical Education Centers (RTECs)
- Reiterate importance of soft skills
- Repurposing existing programs
- Reverse engineering
- Skill contests
- Student chapters/clubs, professional societies, alumni
- Students guided toward nationally-recognized certifications
- Youth academies with at-risk students
SOUTH CENTRAL ENERGY CONVERSATION

JOB CATEGORIES AND TITLES

Note: Highlighted text in this section indicates a regional difference in the job title from the national job titles. It may indicate a difference in wording of the job title or a job title specific to a region that was not identified as a national job title. (National job titles are based on those listed in the national report, Defining Energy Technologies and Services (www.ateec.org/store/)).

FASTEST-GROWING JOBS IN SOUTH CENTRAL U.S.

Energy Conversation participants identified the following occupations as high-demand and rapidly growing jobs in their region. The jobs in black were ranked highest.

- Solar/wind/wave/geothermal resource assessor
- Oil & gas field tech
- Energy optimization tech
- Oil refinery/process tech
- Instrumentation/control tech and process operator
- Oil & gas exploration tech
- Renewable energy systems installer
- Waste management/recycling tech
- Alternative Fuel Vehicle (AFV) repair/maintenance tech
- Biofuels processing tech
- Cogeneration tech
- Energy auditor
- Fuel cell tech
- General sales representative/sales engineer (oil & gas)
- Generator tech
- Geospatial tech
- Offshore logistics coordinator
- Petroleum tech (inside)
- Research tech
- Surveyor/site assessor
- Waste-to-energy tech
- DCS programmer/operator
- Geothermal tech
- Carbon trading analyst
- Solar PV tech
- Boiler tech
- Commissioning tech
- Energy cost analyst
- Geology tech
- Legal aide/insurance specialist
- Remote operating tech
- Solar thermal tech
- TAB tech
SOUTH CENTRAL ENERGY CONVERSATION (cont.)

Buying and Selling Energy
Alternative financing specialist (multiple source incentives)
Billing analyst/rate analyst
Carbon trading analyst
Customer service representative/account executive
Energy broker assistant
Energy contracting specialist (multiple source incentives)
General sales representative/sales engineer (oil and gas)
Landman
Purchasing agent
Renewables, oil, and gas accountants
Renewables, oil, and gas appraisal tech
Technical salesperson (oil and gas)

Energy Assessment
Energy analyst
Energy auditor
Energy portfolio planner
Industrial process specialist
Measurement & verification tech
Renewable energy site assessment tech
  • Biomass
  • Energy efficiency
  • Geothermal
  • Hydropower
  • Ocean energy
  • Solar
  • Windfield

Energy-Efficient Building Construction, Project Engineering, & Implementation
Architecture tech (including LEED)
Commissioning tech, including:
  • Verify systems operation & interoperations
  • Measurement & verification
Energy-efficient construction tech/site foreman (new & retrofit)
Energy optimization tech
Energy project developer/manager, including:
  • Scheduler
  • Engineering tech
  • CAD/CAM tech/draftsperson
  • GIS tech

Program/project coordinator
Renewable energy systems installer
Sustainability coordinator
Testing, Adjusting, Balancing (TAB) tech
Testing/commissioning/decommissioning tech
Waste management/recycling tech

Exploration
Crop yield/biomass analyst (agriculture, aquaculture, & silviculture)
Geology tech
Geophysical tech
Geospatial tech
Oil & gas exploration tech
Research tech
Surveyor/site assessor
Solar/wind/wave/geothermal resource assessor*
Waste-to-energy recovery tech

Generation & Utility-Scale Construction
Biofuels processing tech
Boiler tech
Coal gasification tech
Cogeneration tech
Combustion tech
Energy crop farmer
Fuel cell tech
Generator tech
Geothermal tech
Hydropower tech
Infrastructure/construction tech (installation)
Instrument/control tech & process operator
Nuclear fuel enrichment & reprocessing tech
Nuclear reactor tech
Ocean power tech (tidal & undercurrent)
Oil & gas field tech
Oil refinery/process tech
Petroleum tech (inside)
Remote operating tech
Solar photovoltaic tech
Solar thermal tech
Waste-to-energy tech
Wind turbine tech
**Operations & Maintenance**
- Building automated control systems tech
- Building control operator *(environmental)*
- Digital Control System (DCS) programmer/operator
- Energy cost analyst
- Energy manager
- Equipment maintenance specialist (industrial & commercial)
- Performance monitoring tech
- Resource conservation/efficiency manager

**Regulatory Affairs**
- Code inspector (municipal, county, & state)
- Compliance specialist (municipal, county, state, & federal)
- Incentive auditing (verification)
- Industry standards specialist
- Legal aide/insurance specialist
- Permit specialist
- Plan reviewer/checker
- Surveyor/site assessor
- Testing/verification tech (fuel, appliance, HRVOC, etc.)

**Transmission & Distribution**
- Emergency response tech *(marine, road, & rail)*
- Environmental safety & health tech
- Equipment operator/controls operator
- Fuel storage tech
- Infrastructure/construction tech
- Outage reporting tech
- Pipeline distributed generation tech
- Power engineering tech
- SCADA/telecommunications tech
- Utilities tech

**Transportation (Mobile) Services**
- Alternative Fuel Vehicle (AFV) repair/maintenance tech
- Emissions testing & repair tech
- Fleet manager
- Hazardous materials coordinator
- Off-shore logistics coordinator
- Transportation, warehousing, & logistics tech *(geospatial, planning, public transportation, multi-modal transportation, expediting)*

*Emerging
SOUTH CENTRAL ENERGY CONVERSATION (cont.)

OCCUPATIONAL DATA

Labor Market Data Resources
Algae 2020
Aerotek
Alamo Area Council of Governments
Association of Energy Engineers
Culinary Engineering Staffing
DeVry & ITT Tech—proprietary schools
Energyjobsites.com
Greater Houston Partnership
Houston Galveston Area Council
Labor Market and Career Information
Monster.com
National Algae Association
National Biodiesel Board
RIGZONE.com
Saving With Energy
Texas Workforce Commission
U.S. Department of Labor:
  • O*NET
    o Career Voyages
    o Careeronestop.org
  • Bureau of Labor Statistics

Best Practices
Authenticity—Hands-On/Minds-On:
  • Curriculum
  • Equipment
  • Industry-standard equipment
  • Recent technology
  • Simulators
Balanced programs:
  • Comprehensive
  • Contextual
  • Experienced instructors
    o Industrial experience
    o Pedagogical skills
  • Face-to-face, lab, online
  • Prescriptive, interactive
Best programs provide:
  • Affordability
  • Connection to industry
  • Convenient location & accessible
  • Engaging curriculum
  • E-texts
  • Flexible times (day, evening, online/anytime)
  • Good instructors
  • Internships
  • Placement services
  • Scholarships
  • Student counseling
  • Video game-like activities (interfaces, engaging, whole-brain activity)
  • Well funded
Examples:
  • City of Houston—Green Ribbon Com (SA) & Green Building Resources (e.g., LEED)
  • E2E Energy to Engineers
  • Ecobots
  • Energy4me.org
  • Energy City of 2050
  • Energy Collaborative Committee
  • Leadership Forum
  • Lone Star and Houston Community Colleges partnership
  • Odessa College (CSTEM & STEM)
  • OILSIM
    o Exploration simulation software
      • Choosing prospects
      • Drilling
      • Farm in/out
      • Survey data
    o Modules for production and refining
      • Discovery
      • Drilling
      • Economics
      • Production
    o Troubleshooting/problem-solving for:
      • Chemical engineering tech
      • Petroleum tech
      • Process tech
  • Project Lead the Way
  • Technical Engineering High Schools (KISD, SBISD, HISD, etc.)
  • Texas Girl Project
  • Texas Renewable Energy Industries Association
SOUTHEAST ENERGY CONVERSATION

JOB CATEGORIES AND TITLES

Note: Highlighted text in this section indicates a regional difference in the job title from the national job titles. It may indicate a difference in wording of the job title or a job title specific to a region that was not identified as a national job title. (National job titles are based on those listed in the national report, Defining Energy Technologies and Services (www.ateec.org/store/)).

FASTEST-GROWING JOBS IN THE SOUTHEAST U.S.

Energy Conversation participants identified the following occupations as high-demand and rapidly growing jobs in their region. The jobs in black were ranked highest.

- Solar panel installer
- Lineman
- HVAC tech
- Biomass lab tech
- Carpenter
- Nuclear controls tech
- Electromechanical tech
- Geothermal well driller
- Heavy equipment operator
- Maintenance tech
- Project manager
- Smart grid meter installer
- Smart grid meter mechanic
- Survey & mapping tech
- Weatherization installation tech
- Welder
- Wind system installer

- Wind turbine tech/mechanic
- Hydropower maintenance tech
- Energy auditor
- Biomass harvester
- Chemist/water tech
- Electrician
- Energy consultant
- Gray water plumber
  - IT tech
  - Plumber
  - Safety tech
<table>
<thead>
<tr>
<th>Biomass</th>
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<tr>
<td>Agricultural tech</td>
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<td>Engineering tech</td>
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<td>Harvester</td>
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<td>Heavy equipment operator</td>
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<td>Laboratory tech</td>
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<td>PLC tech</td>
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<td>Process tech</td>
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<td>Silviculturalist</td>
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<td>State inspector</td>
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<td>Building Science (new and retrofit)</td>
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<td>Building inspector</td>
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<td>Carpenter</td>
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<td>Certifying agent</td>
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<td>Cistern fabricator (freshwater collection)</td>
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<td>Electrician</td>
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<td>Energy specialist</td>
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<td>Estimator</td>
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<td>Gray water plumber</td>
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<td>HVAC tech</td>
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<td>Interior designer</td>
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<td>ISO auditor</td>
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<td>Irrigation specialist</td>
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<td>Landscaper</td>
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<td>Lighting specialist</td>
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<td>Material handling specialist</td>
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<td>Smart house tech</td>
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<td>Coal</td>
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<td>Boiler operator</td>
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<td>Ceramics/masonry tech</td>
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<td>Controls tech</td>
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<td>Electromechanical tech</td>
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<td>Environmental tech</td>
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<td>Field service tech</td>
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<td>Heavy equipment operator</td>
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<td>Instrumentation &amp; automation tech</td>
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<td>Machinist</td>
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<td>Maintenance</td>
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<td>Relay tech</td>
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<td>Sub-station tech</td>
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<td>Turbine generator operator</td>
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<td>Underwater welder</td>
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<td>Geothermal</td>
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<td>Geology tech</td>
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<td>Pipefitter/steamfitter</td>
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<td>Plumber</td>
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<td>Well driller</td>
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<td>Hydropower</td>
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<td>Chemist/water tech</td>
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<td>Nuclear</td>
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<td>Community relations specialist</td>
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<td>Controls tech</td>
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<td>Draftsperson</td>
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<td>Fire suppression specialist</td>
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<td>Mechanical tech</td>
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<td>Medical tech</td>
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<td>Nuclear waste manager</td>
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<td>Power plant tech</td>
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<td>Quality control tech</td>
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<td>Radiation safety specialist</td>
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<td>Structural inspector</td>
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<td>Water tech</td>
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<td>Welder</td>
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</tbody>
</table>
OCCUPATIONAL DATA

JOBS

Smart Grid
Computer programmer
Computer specialist/analyst
Grounds man
Lineman
Meter installer
Meter mechanic

Solar
Battery tech
Design tech/daylight
Electrician
Panel installer
Plumber/pool installer
Roof
Sheet metal fabricator/tester
Stamp machine operator
System designer
Thermal installer

Weatherization
Carbon footprint auditor
Energy auditor
Energy inspector
Energy management analyst
Installation tech
Program manager
Weatherization specialist

Wind
Crane operator
Derrick operator
Drill shaft installer
Installer
Mechanical designer
Rigging specialist
Survey & mapping tech
Turbine tech/mechanic
Well head operator

Labor Market Data Resources
Banner Center reports
Bureau of Labor Statistics—U.S. Department of Labor
Central Florida Development Council reports
Enterprise Florida Economic Development reports
Florida Hi-Tech Council reports
Florida Registered/Targeted Occupational reports (WFI-AWI-DOL)
Florida Trends reports
Green Force Florida—Florida Department of Education
O*NET—U.S. Department of Labor
Maddux Report (Florida)
PEW Research Center reports
Sun Biz

Best Practices
Daytona State (CNC)
Florida State College at Jacksonville (Cisco, construction, solar)
Florida State Energy Center (PV, building efficiency, energy auditor)
Hillsborough Community College maintenance and water treatment (Plant City)
Indian River Community College—Banner Center of Energy (nuclear)
Key West High School Alternative Energy Center
Marion Technical Institute (lineman)
Pinellas Technical Center (welding)
Polk State College/Banner Manufacturing Center (industrial maintenance)
TECO Energy—Powerhouse Professional
St. Petersburg College—Florida Green Building Council online courses, networking, solar
installation online courses
University of Central Florida—Banner Center for Alternative Energy
University of Southern Florida—Research & Development Energy Institute & Solar Energy Ctr
Washington Holmes Technical Center (biodiesel)
Westside Technical Center (solar/biodiesel)
FASTEST-GROWING JOBS IN THE SOUTHWEST U.S.

Energy Conversation participants identified the following occupations as high-demand and rapidly growing jobs in their region. The jobs in black were ranked highest.

- Alternative Fuel Vehicle (AFV) repair/maintenance tech (tie for #1)
- Energy auditor (tie for #1)
- Renewable energy systems installer (tie for #1)
- Solar photovoltaic tech (tie for #1)
- Electrical controls tech
- Home Energy Rating System (HERS) rater
- Retrofitting tech (energy efficiency)
- Wind turbine tech
- Small systems designer
- Maintenance tech
- Alternative financing specialist
- Utility worker (lineman)
- Energy-efficient construction tech
- Instrument/control tech & process operator
- Energy project developer/manager
- Energy regulations specialist
- Fuel cell tech
- Environmental safety and health tech
- Commissioning tech
- Salesperson
- Infrastructure/construction worker
- Energy cost analyst
- Lighting specialist
- Small systems designer
- LEED AP (Accredited Professional)
- Program/project coordinator
- Commissioning tech
- Solar resource assessor
- Surveyor/site assessor
- Performance monitoring/continuous commissioning tech
- Permit specialist
- Solar resource assessor
Buying & Selling Energy
Alternative financing specialist (government incentives) (limited tasks at tech level)
Billing analyst/rate analyst
Customer service representative
Salesperson
Sales representative (utility & private)

Energy Assessment
Energy analyst
Energy auditor
Environmental site assessment tech
Home Energy Rating System (HERS) rater
Measurement & verification tech*
Renewable energy site assessment tech,* including:
  • Geothermal
  • Hydropower
  • Ocean energy
  • Solar
  • Windfield site

Energy Efficient Building Construction, Project Engineering, & Implementation
Architecture tech
Commissioning tech
Energy-efficient construction tradesperson/site foreman*
Energy project developer/manager
  • Scheduler
  • Engineering tech
  • CAD/CAM tech/draftsperson
  • GIS tech
  • Estimator
LEED AP (Accredited Professional))
Project developer (meeting RPS standards)
Renewable energy systems installer*
Retrofitting tech (energy efficiency)
Site & building exterior manager
  • Xeriscaping
  • Shading
  • Lighting
Testing, Adjusting, & Balancing (TAB) tech
Testing/commissioning tech (including HVAC)

Exploration
Crop yield/biomass analyst (agriculture, aquaculture, & silviculture)
Geology tech
Geospatial tech (GIS)
Oil & gas exploration tech
Solar resource assessor
Surveyor/site resource assessor
Uranium prospector
Wind resource assessor

Generation & Utility-Scale Construction
Biofuels processing tech*
Boiler tech
Carbon sequestration tech
Coal gasification tech
Coal miner
Cogeneration tech
Combustion tech
Energy crop farmers
Environmental impact assessment tech
Fuel cell tech*
Generator tech
Geothermal tech
Hydropower tech
Infrastructure/construction tech (installation)
Instrument/control tech & process operator
Nuclear fuel enrichment & reprocessing tech
Nuclear reactor tech
Oil & shale & tar sand processing tech
Oil refinery/process tech
Renewable energy small systems design tech
Solar photovoltaic tech
Solar thermal tech
Utility-scale renewable energy installation tech
Waste-to-energy tech
Wind turbine tech

Operations & Maintenance
Building systems tech
Direct digital control (DDC) programmer
Electrical controls tech
Energy cost analyst
Energy manager
Industrial process equipment maintenance & operations specialist
Lighting specialist
Maintenance tech
Performance monitoring/continuous commissioning tech
Program/project coordinator
Renewable energy maintenance tech
Resource conservation/efficiency manager
Waste management/recycling tech

Regulatory Affairs
Code inspector (municipal, county, & state)
Compliance specialist (municipal, county, state, & federal)
Energy regulation specialist
Energy technology program specialist (state & federal)
Fuel testing/verification tech
Incentive auditing (verification)
Legislative aide
OSHA compliance tech
Permit specialist
SOUTHWEST ENERGY CONVERSATION (cont.)

OCCUPATIONAL DATA

TRANSMISSION & DISTRIBUTION
- Electrical energy storage/distribution tech*
- Emergency response
- Environmental safety & health
- Equipment operator/controls operator
- Fuel storage tech
- Infrastructure/construction worker
- Metering tech
- Outage reporting (including smart monitoring)
- Utility worker (lineman)

TRANSPORTATION (MOBILE) SERVICES
- Alternative fuel vehicle (AFV) repair/maintenance tech (including electric vehicle)
- Emissions testing & repair tech
- Fleet manager
- Fuel contamination remediation tech
- Transportation, warehousing, & logistics tech (geospatial, planning, public transportation, multi-modal transportation, expediting)
- Vehicle & storage tank inspector

LABOR MARKET DATA RESOURCES
- Air Quality Management Districts
- American Solar Energy Society
- American Wind Energy Association
- Apollo Alliance
- California Energy and Utility Workforce Consortium
- East LA Skill Center, University of Southern California
- Green for All/Green Jobs Now
- Green Jobs Council
- Green Workforce Collaborative, South Bay WIB
- Global Green
- Go Solar California
- Industry surveys, reports, resources, references, links, etc.—Centers of Excellence for California Community Colleges (www.coeccc.net)
- NEXT 10 (California)
- “Opportunities to Conserve Water in LA Schools” survey—Infrastructure Academy

SOLAR ENERGY INDUSTRY ASSOCIATION
- U.S. Green Building Council
- Utility programs
- Workforce Investment Boards, regional

BEST PRACTICES
- Collaboration with industry to ensure knowledgeable instructors & training programs and that meet industry-set standards
- Certification process through apprenticeship programs

COMMUNITY OUTREACH PROGRAMS
- Green Ambassadors, California environmental charter high schools
- Hands-on training
- Helmets to Hardhats
- Internships, hands-on & both locally & nationally supported
- Job placement program
- Kern Wind Energy Association
- Million Solar Roofs Project

PARTNERSHIP EXAMPLES:
- Airstreams Renewables
- Cero Coso College
- East LA Skills Center
- LA City College
- LA Trade Tech
- Mesalands Community College
- PG&E

PLACEMENT/PERFORMANCE MEASURES & METRICS, CERTIFICATIONS
- Power Pathways, PG&E
- Program sustainability
- Science, Technology, Engineering, & Math (STEM) preparation
- Small business support
- Stockton Energy Train/Pacific Energy Center, PG&E

SUPPORT FOR DAY STUDENTS
- Thirty percent local worker participation

UNIVERSITY OF CALIFORNIA AT LA
FASTEST-GROWING JOBS IN THE NORTHWEST U.S.

Energy Conversation participants identified the following occupations as high-demand and rapidly growing jobs in their region. The jobs in black were ranked highest.

- Energy auditor
- Solar manufacturing production tech
- Wind manufacturing production tech
- Wind turbine mechanic
- Applied wind research assistant
- Auditing tech (utilities)
- Building inspector
- Building systems tech
- Carbon emissions analyst/reducer
- Carbon sequestration tech (terrestrial)
- Drill rig crew (geothermal)
- HAZMAT tech
- Hydropower/micro tech
- Instrumentation/calibration tech
- Inverter specialist
- Process control/board operator
- Smart grid tech
- Solar panel installer
- Solar site assessor
- Wind maintenance tech
- Wind tower installer
- Power quality engineer
- Facility tech
- HVAC tech
- Lineman
- Sealing & insulation specialist
- Solar maintenance tech
- Solar panel repair tech
- Transmission tech
- Wind site assessor
WESTERN ENERGY CONVERSATION (cont.)

**Biomass**
- Agricultural tech
- Biomass mill tech
- Biomethane gas collector/plant operator
- Harvester
- Pipefitters
- Process control/board operator

**Building Science (new/retrofit)**
- Building inspector
- Building/land xeriscaper
- Building systems tech
- Energy auditor
- Energy management optimization specialist
- Facility tech
- Green data center/IT tech
- LEED certifier
- Renewable energy small systems trainer

**Conventional Energy**
- Air quality monitor
- Automobile engine conversion tech
- Automobile mechanic
- Carbon capture & sequestration systems installer
- Carbon emissions analyst/reducer
- CO2 analyst
- Diesel mechanic
- Environmental impact analyst
- Fuel blending tech
- Fuel mix optimizer
- Fuel quality assurance/control/efficiency tech
- Fuel transition analyst
- Gasification tech
- Government regulator/inspector (code compliance)
- Green sustainability event coordinator
- Heavy metal clean-up
- Land reclamation specialist
- Manual extraction audit specialist
- Oil sand tech
- Oil slick tech
- Process tech
- Terrestrial carbon sequestration tech
- Transmission tech
- Wastewater contamination analyst
- Wastewater treatment operator
- Scrubber operator

**Cross-Cutting**
- CAD tech
- Civil engineering tech (construction, surveyor, etc.)
- Construction trades worker
- Cost analyst
- Data analyst
- Energy analyst
- Environmental compliance tech
- GIS tech
- Heavy equipment operator
- Land survey specialist
- Logistics coordinator (transportation & warehousing)
- Machinist
- Manufacturing production worker
- Permitting tech
- Procurement specialist
- Quality inspector
- Reliability assessor
- Safety specialist
- Transportation tech (truck driver)

**Geothermal**
- Drill rig crew

**Hydropower**
- Hydropower/micro tech
- Tidal wave energy tech

**Laboratory/Research**
- Applied wind research assistant
- Genetics tech
- Instrumentation/calibration tech
- Photonics tech

**Solar**
- Solar panel installer
- Solar panelrepairer
- Solar reclamation tech
- Solar site assessor

**Solar/Wind (Combined)**
- Environmental engineering tech
- Inverter specialist
- Maintenance planner
- Maintenance tech
- Manufacturing production tech
- Project tech (installer)
- Remote SCADA operator
- Sales associate
- Small-scale wind/photovoltaic installer
Utilities

Accounting tech
Auditing tech
Electronics tech (install, monitor, & control)
Lineman
High-voltage DC operator
Permitting specialist
Power quality engineer
SCADA interface tech
Smart grid tech
Utility bill interpreter

Weatherization

Building analyst
HAZMAT tech
HVAC tech
Sealing & insulation specialist

Wind

Fiberglass repair tech
Labor billing specialist
On-the-Job (site) trainer
Sourcing & parts acquisition tech
Tower installer
Wind site assessor
Wind turbine mechanic

OCCUPATIONAL DATA

Labor Market Data Resources
American Solar Energy Society report
American Wind Energy Association reports, including white paper for Department of Energy
“Analysis of Denver Metro Region” (www.metrodenver.org)—U.S. Department of Labor (WIRED)
“California Green Jobs Handbook”
Center for Best Practices reports—National Governor’s Association
Colorado Department of Labor and Employment labor information
Energy sectors (www.e-colorado.org)
Industry surveys, reports, resources, references, links, etc.—Centers of Excellence for California Community Colleges (www.coeccc.net)
Larimer County employers survey
LMI Gateway, Colorado
O*NET (onet.org/report/green)—U.S. Department of Labor
State workforce Web sites—Oregon or Washington
“Twenty percent by 2030”—U.S. Department of Energy
Upstate/Northern Colorado Economic Development Corp.—underemployed statistics

Best Practices
Advanced Technology Environmental and Energy Center (ATEEC)—Energy resources
AIMS, non-credit/short-term—MIST
Biodiesel Co-op of Denver
Biodiesel Reactor, Photovoltaic & Solar Thermal programs—Golden West Community College
Building Efficiency Management, Power Plant Technology, & CNC programs—Colorado Northwestern Community College
CARE program—Victor Valley College
Clean Energy Technician program; Energy Boost, short-term—Front Range Comm. Coll.
Energy efficiency training—Veterans Green Jobs
Green Building program & BPI certification—Colorado Mountain College
Lineman programs—Manhattan Technical College, Trinidad State Junior College, Pratt Community College
NABCEP-approved training
Smart Grid Institute—Colorado State University/Spirae
Solar program, non-credit/short-term—Arapahoe Community College
Weatherization/Building Science & Energy Auditing programs—Lane Community College
Wind Technology program—Laramie County Community College
CERTIFICATIONS (INCLUDES MANDATED AND VOLUNTARY)

Automotive
- Alternative Fuel Vehicles (AFV): Chemical Safety Assessment (CSA) America—Compressed Natural Gas (CNG) Tank Inspection certification
  - Characteristics of CNG
  - Codes & standards of CNG cylinders, valves, pressure relief ducts
  - Cylinder installation/disposal/inspection
  - Electrical diagnostics
  - Fuel system inspection
  - System defueling
  - Tank safety/inspection
- American Society of Engineers—hybrid vehicle certification
- American Society of Engineers—hydraulic
- BQ-9000 certification (biodiesel)
- International Society of Automation (ISA)—instrumentation & process control
- National Alternative Fuels Training Consortium
- National Automotive Technicians Education Foundation/Automotive Service Excellence (NATEF/ASE)

Building science
- American Institute of Certified Planners (AICP)
- Association of Energy Engineers (AEE)—energy auditor power quality operator (5 years of experience); energy manager (in-training)
- Building Operator Certification (BOC)
- Building Performance Institute (BPI)—energy auditor
- Chicago Climate Exchange—Carbon Foot Printer Verifiers
- Energy Star Homes
- HERS (Home Energy Rating System) Rater—Home Energy Auditors certification
- Green Advantage
- International Building Code (IBC)—electrical, HVAC, plumbing, construction science
- International Maintenance Institute
- International Society of Automation (ISA) Control System Technician
- Instrumentation certification
- LEED (Leadership in Energy and Environmental Design) Green Building Rating System
- Logistics technician certification
- Master arborist
- Master forester
- National Center for Construction Education and Research (NCCER) construction curriculum
- Real estate industry home inspectors required to be licensed
- RESNET (Residential Energy Services Network)—new construction

Building trades (residential, commercial, industrial)
- American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) certification
- Equipment operator
- Forklift
- HVAC
- National Geothermal Association—well driller certification
- Pipefitting
- Plumbing
- Roofer
- Stationary operator engineering license (by state)
- Welding
Carbon credits—ISO 14000, 5000
Career preparedness—National Careers Readiness Certification
  • ACT WorkKeys®
  • Math, reading, information search
Electrical
  • Electrician—4 to 5-year apprenticeship; not mandated
  • Continuing Ed—CEUs vary by jurisdiction
  • Journeyman—licensing varies by jurisdiction
  • Master license
INPO (Institution for Nuclear Power Operation)
Internal training/certification
Licensed home improvement contractor
Manufacturing certifications (trade-specific)
  • QA/QC (quality assurance/quality control)
  • SME (Society of Mechanical Engineers)—certified manufacturing technician
Safety/OSHA requirements
  • 10-hour safety certification
  • Confined space rescue
  • CPR
  • First aid
  • Forklift
  • HAZMAT
  • Radiation/health certification for nuclear
Site Assessment
  • Biomass licensed surveyor
  • Midwest Renewable Energy Association (MREA)
  • Site assessors and inspectors—emerging (by state)
Solar
  • Limited renewable energy tech (currently only for PV, certified by State of OR)
  • NABCEP (North American Board of Certified Energy Practitioners) certification—PV & thermal
Transmission and distribution
  • Fall arrest & high angle rescue (also for wind)
  • Lineman—apprenticeship & journeyman
  • Regional power operators requiring certification of transmission system operator
U.S. Department of Transportation—certification for:
  • Commercial Drivers License (CDL)
  • Hazard Communication (HAZCOM)
  • OQ licenses (transport of hazardous waste, etc.)
Water
  • Wastewater management
  • Wastewater operator
Wind
  • American Wind Energy Association (AWEA)—U.S. certification in progress/B2EE, German wind certification
  • High voltage & switching safety certification for utility-scale wind
  • NABCEP certification—small wind (pending)
CROSS-CUTTING TECHNICAL KNOWLEDGE AND SKILLS

Business ethics
Business fundamentals
- Budgets
- Energy economics
Cable splicing and fabrication
Carpentry, basic
Characteristics of materials
Codes, regulations, & laws (application)
Computer systems
- CAD/CAM basics
- Data recording
- Internet use
- Keyboard
- Modeling applications
- MS Office programs
- Programming (PLCs)
- Simulation programs
- Spreadsheets, word processing
Conducting feasibility studies
Construction, basic (windows, doors, etc.)
Control systems, basic
Customer service
Diagnostics
Drafting
Drivers license/CDL
Electricity/electronics theory, basic
Electrical/mechanical systems & integration
Emergency response
Energy literacy (basic knowledge)
- Applied
- Economics
- Engineering
- Sources & distribution
Environmental/energy laws & regulations
- Policy tax incentives
Environmental/sustainability concepts, basic
Environmental requirements (e.g., HAZMAT, waste disposal)
Exposure to field work
Hand tools/power tools/large equipment
HVAC, basic
Hydraulics/pneumatics
Industry maintenance practices
Industry principles & concepts
Interdisciplinary knowledge
Kinesthetic learning aptitude (hands on)
Lab skills
Legacy skills (systems)
Lifecycle analysis
Logistics/supply chain management, basic
Machining
Measurement/metrology
Mechanical/electrical connections
Materials handling
Math & science, applied
- Chemistry, basic
- College-level algebra
- Data analysis
- Construction calculations (e.g., estimation)
- Degree of competency
- Geometry
Physics, applied
Thermodynamics, basic
Translated/applied math
Trigonometry, pre-calculus
Return-on-Investment (ROI) calculation
Measure/estimate energy use
Mechanical equipment (diagnose & repair)
Mechanics/hydraulics, basic
Motors & controls
Planning & organizing
Plumbing
Power systems
Presentation abilities
Problem-solving & critical thinking skills
(exposure to scientific methodology)
- Research
- Scientific method
Process controls/instrumentation systems
Print reading
Quality assurance/quality control (QA/QC)
Quality continuous improvement
Read blueprints/schematics
- Mechanical
- Electrical
- Landscape
Read plans (energy terminology/acronyms/units of energy)
Read engineering drawings
Records/bookkeeping
Safety & health (awareness, training, & practices)
- Electrical & electrical metering safety (NFPA 70E)
- Electrical/fire code compliance (NEC)
- First aid/CPR
- HAZMAT
- Instrumentation
- OSHA 10-hour training
- Personal, environmental, & facility applications
- Rooftop safety
CROSS-CUTTING TECHNICAL KNOWLEDGE AND SKILLS (cont.)
Sheet metal fabrication
Sustainability awareness
Tool use (hand, power, ladder)
Troubleshooting
Technical aptitude/mechanically inclined/spatial relationship
Waste management
Welding
Wind-specific basics, not covered above:
• Basic rigging
• Climbing
• Torque & tensioning certification
• Tower rescue

CROSS-CUTTING EMPLOYABILITY KNOWLEDGE AND SKILLS

ACT WorkKeys® foundation skills:
• Applied math
• General writing
• Listening
• Locating information
• Observation
• Reading for information
• Technical writing

Communication
• Cell phone/technology etiquette
• Data recording accuracy (notebooking skills)
• Email/text
• Language skills
  o Good English-speaking skills (applicable to the needs of job)
  o Need to have appropriate language skills for safe & proper work
• Listening
• Networking
• Reading with comprehension
• Speaking (e.g., interpersonal, public presentations)
• Writing, technical & report

Interpersonal
• Collaboration/team building
• Conflict resolution
• Desire to participate
• Empathy
• Intergenerational interaction
• Respectfulness
• Tolerance of diversity (e.g., race, age, culture)

Miscellaneous
• Encourage more than English speakers (English speakers to adopt second language)
• Entrepreneurial skills
• Sustainability awareness/practices

Personal effectiveness
• Ability to learn
• Accountability
• Balance of long-term goals & instant gratification
• Dependability
• Ethics/social responsibility
• Flexibility & adaptability
• Integrity
• Personal hygiene
• Professionalism
• Motivation
• Reliability
• Self-care (physical & mental health)
• Self-development (ongoing)

Professional development
• Career awareness/networking (Web navigating)
• Interview skills
• Leadership/initiative
• Lifelong learning

Professionalism
• Appropriate workplace dressing
• Business etiquette (bosses, clients)
• Marketing (e.g., company, oneself, networking)
• Office etiquette (e.g., noise, food, cleanliness)
• Plays well with others
• Promptness (Be on time.)

Work skills (requires high school introduction/reinforcement)
• Critical thinking
• Decision-making
• Flexibility (organizational fit)
• Long-term thinking
• Planning, organizing, & scheduling
• Problem-solving
• Research skills
• Time-On-Task (TOT)
  o Deadlines
  o Learn how to make time
  o Prioritization
  o Stay ahead of the game
  o Timelines
  o Time/project management
• Working with tools & technology
CROSS-CUTTING EMPLOYABILITY KNOWLEDGE AND SKILLS

**Workplace requirements**

- Bigger picture thinking
- Business fundamentals
- “Chain of command” skills & group culture
- Cross-functional teams/matrix management
- Following directions
- High school/GED
- Teamwork
- Pass a drug test
- Safety consciousness & practice
- Sales techniques
- Security/background check
- Supervising others
- Working with clients
FUTURE TRENDS

Aging systems in the field will need updating (materials, mechatronics, electronics, etc.)
Battery (storage) technology development
Better building energy codes
Biodiesel heavily dependent on oil prices & government direction
Biomass exchanges
Building codes
CAFE standards
California State Bill 811, homeowner incentives for renewable energy
Cap & trade
Carbon analyst may eventually be a technician-level position
Carbon regulations
Carbon sequestration
Carbon tax
Car-sharing memberships
Change in economies of scale
Changes in degree completion
Class enrollments
“Clean” energy definition (e.g., to include nuclear or not)
Climate change issues
Collaborations—examples:
  • Biofuels and petrochemicals
  • Biotechnology and refining
  • Field instrumentation and lab instrumentation
Colorado solar tax credits
Company incentives from state/federal government
Concentrated solar—discussion about efficacy
Consumer sales
  • Educate the public
  • Represent the product/service
  • Talk the green talk
Continuing hydrogen research (possible non-interest by government, public vs. private funding for research)
Cross-disciplinary movement—technicians will operate across disciplines
Cultural/social change
Decoupling of utilities
Desalination
Distributed generation with renewables
  • 1 to 5 megawatts throughout region
  • Homeland Security
Economic vs. workforce development
Economies of learning (better, cheaper, more efficient)
Electrical energy storage
Electrical grid development, smart grid/national grid/grid growth
Electric vehicle car conversion, charging stations
Emerging regulatory issues (environment, safety, livability)
Energy auditing (legislation may increase need)
Energy education
  • Educate delivery systems
  • Accountability—getting performance & metrics in need
  • Energy educators—need more, quantity & quality
  • Energy efficiencies at all levels:
    o Design & construction
    o Insulation
    o Lighting, appliances, HVAC
    o Residential/commercial/industrial
    o Retrofitting
Energy management/Smart Grid
Energy measurement (e.g., smart meters)
Energy programs in high schools
Equipment investments
Excitement in the change/social movement
Existing business community into green business
Expanded performance contracting
Expanding markets
Farmers adding renewable energy
Federal tax policy
Feed-in tariffs (ART)
Fuel cells/energy storage
Gas/oil cost to drive much of the direction
Globalization
GMO/NQNO technology > biomass
Green economy—public demand for green products/services.
Greenhouse gas regulations
Green mortgage availability
Heating & cooling district utilities
Hybrid cars—heavy use
Increased clean air regulations (e.g., CAFE standards)
Increased efficiency of PV technologies
Increased energy efficiency
Increased federal support
Increased freight rail transportation of wind blades
Increased interest in sustainability
Increased siting/land use conflicts
Increased solar thermal use
FUTURE TRENDS (cont.)

Increased venture capital investment for new green technologies
Industry capital investment incentives
Infrastructure—can’t forget immediate needs
Innovation integration
“Ipod’ing” of the world—avoid form over function (e.g., energy sales, education)
Large-scale transmission build-out
LED lighting
Legislation
- Economic recovery—innovations/innovations
- Tax credits, incentives, & subsidies—given to all sectors
Lifecycle analysis—educating business on green economy
Looming disaster (moves society to action)
Manufacturing (PV, wind, etc.)
Mass transit/smart growth
Measured entry into business (not too quick)
Mentoring/volunteerism
Municipal governments as energy planners
National transmission policy
Net metering
New business models (renewables)
New manufacturers (e.g., Pittsburgh model one or two small green technologies)
Non-traditional biomass markets (equipment/high tech)
Nuclear—Mid-Atlantic is hotspot for the nation
Nuclear plants—question of new builds
Offer quality programs
Offshore oil & gas exploration
Online training
Paraprofessionals enabled by technology to do tasks formerly done by professionals
PATH MAPP T-line projects
Policy shifts that support renewable energy—tenants/owners
Public demand—solar
Public education
- Energy at K-12 level
- Social awareness
- Technician training (career opportunities)
PV storage technology (efficiency—innovations)
R&D leading to lower costs
Rapid changes in regulations
Redesign/refit tech (to address new needs)
Regional energy management
Regulatory requirements of utilities—30% rule
Renewable energy distribution/energy security issues
Renewable fuel students
Renewable Portfolio Standards
Retirements (estimated 50% over next 10 years)
Retrofitting existing homes
Reuse of wind turbines
Simulations
Small businesses like to use technicians at times & experienced retired experts at other times.
Small contractors (e.g., plumbers, electricians, HVAC) will add 1 to 5 jobs per company to add solar, small wind, geothermal
Smaller house sizes
Small wind power safety & performance standard
Smart energy storage
Smart grid (appliances, homes, meters, vehicle-to-grid)
Smart-grid development
Smart grid—new generation—real-time consumer awareness
Smart growth—transit-oriented development, land development, urban planning (e.g., Reston model, mixed-use)
Social networking (increased value)
Solar—large-scale utility-based
Solar/wind-powered EVs
State support linkage to markets & retooling
Time-of-Use metering
Training/education system—ongoing flux
Training for local jobs
Transit workforce/home ownership
Transition movements—planning
Transportation investments
Union issues
Upward trends of solar PV
Utilities-owned renewables
Waste disposal/recycling of building materials
Water—becoming an environmental & energy priority
Water conservation (e.g., brown/black water, reclamation, reuse, sustainable landscape)
Water scarcity (includes U.S., not just global)
Water use/energy relationship will further promote energy pathway—more discussion
Wave/ocean energy
Weatherization—small businesses & agencies
Workplace policies (e.g., schedules, telecommuting)
### MID-ATLANTIC ENERGY CONVERSATION
**Host: Community College of Baltimore**

- Ron Belbot
  - Severstal-Sparrows Point

- Tom Blackburn
  - Severstal-Sparrows Point

- George Evans
  - MDR Group

- Dennis Farber
  - Community College of Baltimore

- Paul Gietka
  - MTES

- Steve Goad
  - BGE

- Scott Jorda
  - Digna Machine

- Rick Lank
  - Energy Stewardship

- Elizabeth McAndrews-Benevides
  - Nuclear Energy Institute

- James J. Nagle
  - Eneractive Solutions

- Dave Norfolk
  - Baltimore Electrical Joint Apprenticeship & Training Committee

- Phillip Polefrone
  - UniStar Nuclear Energy

- Ann Randazzo
  - Center for Energy Workforce Development

- Michael Rothmeier
  - Simple Solutions Consulting

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### NORTH CENTRAL ENERGY CONVERSATION
**Host: Madison Area Technical College**

- Jim Collins
  - H & H Electric

- Alex DePillis
  - EcoEnergy

- Dave Donovan
  - Xcel Energy and Wisconsin Distributed Resources Collaborative

- Bill Guiney
  - Johnson Controls

- Tony Hartmann
  - Biodiesel Association

- Bill Johnson
  - Alliant Energy

- Roger Kasper
  - Department of Agriculture, Trade, and Consumer Protection

- Ingrid Kelly
  - Energy Center of Wisconsin

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### REGIONAL HOST INSTITUTIONS, PARTICIPANTS, AND CONTRIBUTORS

- Ron Belbot
  - Severstal-Sparrows Point

- Tom Blackburn
  - Severstal-Sparrows Point

- George Evans
  - MDR Group

- Dennis Farber
  - Community College of Baltimore

- Paul Gietka
  - MTES

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- Scott Jorda
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### NORTHWEST ENERGY CONVERSATION
**Host: Portland Community College**

- Jennifer Askew
  - Vestas
- Mel Cossette
  - MatEd Resource Center
- Paul Croker
  - Lane Community College
- Michael Davis
  - Portland Community College
- Maureen Fallt
  - Portland General Electric
- Barbara Hins Turner
  - Center of Excellence for Energy
- Eric Kirchner
  - Portland Community College
- Lynn Nakamura
  - Lane Community College
- John Patterson
  - Mr. Sun Solar
- Diane Redinger
  - SolarWorld
- Frank Rytkonen
  - Jacobs Engineering/OIT/ISA
- Todd Sanders
  - Portland Community College
- Jackie Sandquist
  - Portland Community College
- Angela Schmiede
  - Earth Advantage Institute
- Bonnie Starkey
  - Portland Community College
- Paul Wild
  - Portland Community College
- Sanda Williams
  - Portland Community College
- Amy Youngflesh
  - Portland Community College
- Hector Aguilar
  - Austin Community College
- Sajjad Ahmed
  - Air Liquide
- Dan Allan
  - Lab Resources
- Keith Avery
  - Hampden Engineering Corp.
- Sidney Bolfing
  - Texas State Technical College
- Audrey Brooks
  - BP
- Lisa Ann Cairns
  - Ontility
- Chuck Carter
  - Fieldbus Center at Lee College
- Megan Costanza
  - Lone Star College
- Robin Dahlheim
  - Gulf Coast Green Energy
- Susannah Erler
  - Austin Community College
- Linnea Fletcher
  - NSF Program Officer

### SOUTH CENTRAL ENERGY CONVERSATION
**Host: Houston Community College**

- Hector Aguilar
  - Austin Community College
- Sajjad Ahmed
  - Air Liquide
- Dan Allan
  - Lab Resources
- Keith Avery
  - Hampden Engineering Corp.
- Sidney Bolfing
  - Texas State Technical College
- Audrey Brooks
  - BP
- Lisa Ann Cairns
  - Ontility
- Chuck Carter
  - Fieldbus Center at Lee College
- Megan Costanza
  - Lone Star College
- Robin Dahlheim
  - Gulf Coast Green Energy
- Susannah Erler
  - Austin Community College
- Linnea Fletcher
  - NSF Program Officer

- John Galiotos
  - Houston Community College
- Cecilia Galliano
  - Austin Community College
- Eddie V. Gray
  - Gray Enterprises
- J. Hawkins
  - AAA-Chemicals
- Linda Head
  - Lone Star College
- Daniel Kainer
  - Lone Star College
- Jo Keimns
  - Green Mechanical Council
- Larry Lee
  - Del Mar College
- Janarde Lepore
  - PiControl Solutions
- Pat Merritt
  - Traton Engineering
- Thomas Mort
  - Thomas Mort Consulting
- Ursula Pike
  - Austin Community College
- Harry Priesmeyer
  - Workforce Solutions
- Bill Schraer
  - WFDC
- Linda Smarzik
  - Austin Community College
- Dalip Sondhi
  - Furr High School
- Gregory South
  - Odessa College
SOUTH CENTRAL ENERGY CONVERSATION (cont.)
Homer Stewart
Houston Community College
Dale Taggart
Houston Community College
Xuan Vandeberg Harris
SPE/SWE/IEEE

SOUTHEAST ENERGY CONVERSATION
Host: Hillsborough Community College
Cindy Amor
Teco Energy
Sheryl Awtonomow
Brevard Community College
Marilyn Barger
Hillsborough Community College
Cindy Bumgarner
Midwest Research Institute
Joe Elovich
Tampa Bay Trane
Rick Frazier
Tallahassee Community College
Richard Gilbert
University of Southern Florida
Leigh Haller
Chrysalis Design Services
Craig Hardesty
Hillsborough Community College
Ernie Helms
Polk State College
Richard Hyatt
Southern Edison System
Everton Jackson
Polk State College
Brian Kuyatt
Hillsborough Community College
Kim McDougal
Florida Department of Education
Kurt Morauer
Rising Force Construction
Eric Roe
Hillsborough Community College
Bill Roshon
Edison State College
Terri Scott
Hillsborough Community College
Jim Simpson
Florida State College-Jacksonville
Keith Simpson
Labvolt.com
Stan Vittetoe
St. Petersburg College
Sudeep Vyapari
Hillsborough Community College

SOUTHWEST ENERGY CONVERSATION
Host: College of the Canyons
Kathleen Alfano
College of the Canyons
Eddie Barnes
Consultant
Paul Beeson
Solar industry expert
Jerry Butkiewicz
Sempra Energy
Marsha Buterbaugh
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Eun-Woo Chang
NSF Program Officer
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Imani Energy, Inc.
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Airstreams
Sharon Dwyer
Ventura County Community College District
Steve Factor
Solar City
Lisa Gilbert
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Brano Goluza
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Brian Hurd
Hands-On Solar
Tom King
PHAT Energy
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Jim Nichols
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Peter Parrish
Cal Solar Engineering

Deep Patel
Go Green Solar

Mario Rendon
PG&E

Jeffrey Richardson
Imani Energy, Inc.

Keith Rypka
College of the Canyons

WESTERN ENERGY CONVERSATION
Host: National Renewable Energy Laboratory

Doug Cook
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