Hawai‘i’s Green Workforce

Green Occupational Profiles

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Table of Contents

Hawai'i's Green Workforce: Green Occupational Profiles

Foreword

The Department of Labor and Industrial Relations (DLIR) has actively sought to become a more effective partner in steering the State of Hawaii toward a sustainable green economy. Recognizing the rapidly evolving needs of the clean energy sector and the limitations of existing labor market information (LMI), Hawaii was one of several states selected by the U.S. Department of Labor's Employment & Training Administration to receive an LMI Improvement Grant funded through the *American Recovery and Reinvestment Act* (ARRA).

This publication supplements a report released in December 2010, *Hawai'i's Green Workforce: A Baseline Assessment*.

The green career profiles presented in this report reflect new and emerging green occupations as defined in the Occupational Information Network (O*NET) program. In addition to detailed information regarding the skills, knowledge and competencies associated with each occupation, we provide summary statistics on local wages and an employment outlook. Career pathways are articulated with information on education and training requirements, including resource providers.

While these career profiles can be utilized as an independent resource, we encourage job seekers and other community members to tap other sources of information as well. The DLIR's Green Jobs Portal (www.GreenJobsHawaii.org) provides a real-time listing of green jobs available locally, and our One-Stop Career Centers are dedicated to providing free services to job seekers and employers, including job search assistance, personal career planning services, training opportunities, HireNet Hawaii support, and a library resource center.

While we have made every effort to validate the accuracy of data in this publication, the State of Hawaii and Department of Labor & Industrial Relations provide the content for educational and informational purposes only. References to specific products, services or companies are for illustrative purposes only, and do not reflect an endorsement by the State of Hawaii, DLIR or its affiliated agencies.

Electronics Engineering Technologists

At a Glance

- Work with engineers to solve technical problems
- Have at least an associate degree
- Use computers heavily
- Usually work on a team
- May specialize in one type of electronic device, such as a cell phone
- Earn $68,140 per year (Hawai'i median)

Overview

Electronics engineering technologists help engineers design, test, and implement new electronics systems or products.

Electronic engineering technologists are knowledgeable about both the theory and practice of applied electronics engineering. This means that technologists have a very good grasp of mathematics and science. They use math and science skills to do everything from testing circuits, systems, devices, and networks to designing new prototypes.

Because the field of electronics is so broad, technologists work in a variety of settings. They may work for research laboratories, government agencies, or for semiconductor factories. They can apply their knowledge to medicine and biology or to the computer science field. Their skills and knowledge can be used to develop anything from robots to new ways to manage energy utilities. In the field of manufacturing, electronics engineering technologists may concentrate on developing green technology and energy efficient manufacturing processes.

The job duties of a technologist vary depending on the specific field. At the heart of each job, though, are the same tasks. This usually involves researching and analyzing a system, process, or new design. Technologists also design and test new ideas and prototypes of new devices. They may fix or adjust an electronics product or system, depending on what it needs. They may supervise and inspect a newly installed computer network, for example, and suggest minor changes.

Electronics engineering technologists use specialized hand tools to perform repairs, adjustments, and maintenance. They also use computer-aided-design software to make digital designs and images. Therefore, technologists must be computer savvy but also understand all parts of the devices and systems they are working with.

Specific Work Activities

The following list of occupational tasks is specific to electronics engineering technologists.

- Analyze and put in place engineering designs for producing electronic devices, systems and microprocessor-based control applications.
- Analyze and implement digital signal processing, network analysis, and computer engineering.
- Conduct or supervise the installation and operation of electronic equipment and systems.
- Evaluate machine and process control requirements. Develop device and controller specifications that will work well in a particular environment.
- Supervise the building and testing of prototypes of electronics circuits, equipment, and systems.
- Inspect newly installed equipment to adjust or fix operating problems.
- Integrate software and hardware components.
- Use computer-aided design software to produce electronics drawings of controls, instruments, sensors, and telecommunications networks.
- Replace damaged components and parts using hand tools and precision instruments.
- Select electronics equipment, components, and systems to meet specifications.

- Set up and operate test equipment to diagnose, test, and analyze the performance of electronic components, assemblies, and systems.

Common Work Activities

Electronics engineering technologists perform the following list of tasks, but the tasks are common to many occupations.

- Use computers.
- Repair and maintain electronic equipment.
- Make decisions and solve problems.
- Update and use job-related knowledge.
- Get information needed to do the job.
- Communicate with supervisors, peers, or subordinates.
- Identify objects, actions, and events.
- Inspect equipment, structures, or materials.
- Document and record information.
- Analyze data or information.
- Evaluate information against standards.
- Think creatively.
- Process information.
- Monitor events, materials, and surroundings.
- Establish and maintain relationships.
- Organize, plan, and prioritize work.
- Explain the meaning of information to others.
- Control machines and processes.
- Communicate with people from outside the organization.
- Judge the value of objects, services, or people.

Related Occupations

This occupation is part of the **Science, Technology, Engineering, and Mathematics** cluster of occupations.

Related occupations include:
- Electrical and Electronics Engineers
- Engineering Technicians
- Fuel Cell Technicians
- Geothermal Technicians
- Industrial Electronics Repairers
- Manufacturing Engineering Technologists
- Mechanical Engineers

Hawai‘i Career Pathway:
- Industrial & Engineering Technology

Related O*NET Specialties:
- Electronics Engineering Technologists

Skills and Abilities

Electronics engineering technologists need to:

COMMUNICATE

- Listen to others, understand, and ask questions.
- Read and understand work-related materials.
- Express ideas clearly when speaking or writing.

REASON AND PROBLEM SOLVE

- Develop rules or follow guidelines for arranging items.
- Use reasoning to discover answers to problems.
- Analyze ideas and use logic to determine their strengths and weaknesses.
- Combine several pieces of information and draw conclusions.
- Notice when something is wrong or is likely to go wrong.
- Identify problems and review information. Develop, review, and apply solutions.
- Concentrate and not be distracted while performing a task.
- Determine how a system should work. Study how changes in conditions affect outcomes.
- Judge the costs and benefits of a possible action.
- Understand new information or materials by studying and working with them.
- Think of new ideas or original and creative ways to solve problems.

USE MATH AND SCIENCE

- Use math and science skills to solve problems.
- Add, subtract, multiply, and divide quickly and correctly.

MANAGE ONESELF, PEOPLE, TIME, AND THINGS

- Check how well one is learning or doing something.
- Manage the time of self and others.

WORK WITH PEOPLE

- Be aware of others' reactions and change behavior in relation to them.
- Teach others how to do something.

WORK WITH THINGS

- Determine the causes of technical problems and find solutions for them.
- Maintain equipment on a routine basis. Determine when and what kind of maintenance is needed.
- Repair machines or systems.
- Test and inspect products, services, or processes. Evaluate quality or performance.
- Watch gauges, dials, and output to make sure a machine is working properly.
- Determine the tools and equipment needed to do a job.
- Operate and control equipment.

PERCEIVE AND VISUALIZE

- Imagine how something will look if it is moved around or its parts are rearranged.
- Identify a pattern (a figure, object, word, or sound) that is hidden in distracting material.
- Quickly and accurately compare letters, numbers, objects, pictures, or patterns.

Working Conditions

In a typical work setting, electronics engineering technologists:

INTERPERSONAL RELATIONSHIPS

- Communicate daily by telephone, e-mail, and in person. They also use letters and memos, but less often.
- Are somewhat responsible for the work done by others.
- Are responsible for the health and safety of others.
- Have a medium level of social interaction.
- May work as part of a team.

PHYSICAL WORK CONDITIONS

- Work indoors.
- Sometimes wear protective or safety attire.
- Are occasionally exposed to hazardous conditions.
- May on occasion be exposed to loud or distracting sounds and noise levels.
- Work near others. They often share the same office space with other engineers.

WORK PERFORMANCE

- Must be very exact and accurate when performing the job. Errors to a product design can affect users' safety.
- Make decisions that affect other workers or the company's reputation on a monthly basis. For larger decisions, they consult a supervisor before deciding a course of action.
- Set nearly all their daily tasks and goals without talking to a supervisor first.
- Must meet strict weekly deadlines. This may make the work atmosphere somewhat competitive.
- Repeat the same physical and mental tasks.

HOURS / TRAVEL

- Generally have a set schedule each week.
- Usually work 40 hours a week. However, overtime is common, especially when meeting project deadlines.

Physical Demands

Electronics engineering technologists frequently:

- Use their hands to handle, control, or feel objects, tools, or controls.
- Sit for long periods of time.

It is important for electronics engineering technologists to be able to:

- See details of objects whether they are nearby or far away.
- See differences between colors, shades, and brightness.
- Hold the arm and hand in one position or hold the hand steady while moving the arm.

- Use fingers or hands to grasp, move, or assemble very small objects.
- Understand the speech of another person.
- Speak clearly so listeners can understand.

It is not as important, but still necessary, for electronics engineering technologists to be able to:

- Make quick, precise adjustments to machine controls.
- Move two or more limbs together (for example, two arms, two legs, or one leg and one arm) while remaining in place.
- Determine the distance between objects.
- Hear sounds and recognize the difference between them.
- Use stomach and lower back muscles to support the body for long periods without getting tired.
- React quickly using hands, fingers, or feet.
- Focus on one source of sound and ignore others.
- Bend, stretch, twist, or reach out.
- Choose quickly and correctly among various movements when responding to different signals.
- Coordinate movement of several parts of the body, such as arms and legs, while the body is moving.
- Make fast, repeated movements of fingers, hands, and wrists.
- Use muscles to lift, push, pull, or carry heavy objects.

Knowledge

Electronics engineering technologists need knowledge in the following areas:

- Computers and Electronics: Knowledge of computer hardware and software.
- Mathematics: Knowledge of the rules and uses of numbers. Areas of knowledge include arithmetic, algebra, geometry, and statistics.
- Engineering and Technology: Knowledge of how to build machines, buildings, and other things. Also includes knowledge of how to use computers, machines, and tools to do work more usefully.
- Telecommunications: Knowledge of the equipment that is used to send messages as electronic impulses. Examples include radio, television, telegraph, and cable.
- Physics: Knowledge of the features and rules of matter and energy. Areas of knowledge include air, water, light, heat, weather, and other natural events.
- English Language: Knowledge of the meaning, spelling, and use of the English language.
- Design: Knowledge of making and using plans, blueprints, drawings, and models.
- Mechanical: Knowledge of designing, using, and repairing machines and tools.
- Customer and Personal Service: Knowledge of providing special services to customers based on their needs.
- Education and Training: Knowledge of teaching and the methods involved in learning and instruction.
- Production and Processing: Knowledge of how products are made and supplied.

Interests

Electronics engineering technologists are people who tend to:

- Consider achievement important. They like to see the results of their work and to use their strongest abilities. They like to get a feeling of accomplishment from their work.
- Consider recognition important. They like to work in jobs which have opportunities for them to advance, be recognized for their work, and direct and instruct others. They usually prefer jobs in which they are looked up to by others.
- Consider support from their employer important. They like to be treated fairly and have supervisors who will back them up. They prefer jobs where they are trained well.
- Consider independence important. They like to make decisions and try out ideas on their own. They prefer jobs where they can plan their work with little supervision.
- Consider good working conditions important. They like jobs offering steady employment and good pay. They want employment that fits their individual

work style. They may prefer doing a variety of tasks, working alone, or being busy all the time.
- Have realistic interests. They like work activities that include practical, hands-on problems and solutions. They like to work with plants, animals, and physical materials such as wood, tools, and machinery. They often prefer to work outside.
- Have investigative interests. They like work activities that have to do with ideas and thinking. They like to search for facts and figure out solutions to problems mentally.

OCCUPATIONAL INTEREST CODES

- RIC

Wages

Pay varies with the worker's level of education, responsibility, and experience. Those who work in manufacturing may belong to a union. When they work overtime or on holidays, they are usually paid more than their usual wage.

Full-time technologists generally receive benefits. Typical benefits are health insurance, a retirement plan, sick leave, and paid vacation. Some companies provide money for continuing education classes.

Location	Pay Period	25%	Median	75%
Hawai'i	Hourly	$25.69	$32.76	$40.54
	Yearly	$53,440	$68,140	$84,330
Honolulu	Hourly	$26.64	$33.75	$41.63
	Yearly	$55,410	$70,190	$86,600
United States	Hourly	$20.47	$27.66	$34.87
	Yearly	$42,580	$57,530	$72,520

Outlook

In Hawai'i, outlook information is not available specifically for electronics engineering technologists. However, they are included in a larger group of "engineering technicians except drafters, all other."

Slower than average employment growth is expected for workers in this group through 2018.

Nationally, the number of jobs for workers in this group is expected to grow slower than average through 2018.

The table below provides information about the number of workers in this occupation in various regions. It also provides information about the expected growth rate and future job openings.

EMPLOYMENT

Major employers:
- Engineering firms
- Federal, state, and local government agencies

OUTLOOK

Competitive pressures will force companies to improve and update manufacturing facilities and product designs. These changes will increase the need for technologists. However, advances in technology are making technologists more productive. Examples of these advances are computer-aided design and computer simulation. These advances may reduce the number of technologists needed to do the same amount of work.

Employment of electronics engineering technologists is related to the economy. During slow periods, technologists will find fewer job openings. International competition will also limit the growth of this occupation.

	Employment		Employment Change	
	2008	2018	Number	Percent
National	76,600	80,600	4,000	5.2
State	630	640	10	1.6

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound

students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later.

If you attend a private school, check with your school counselor for graduation requirements. Electronics engineering technologists need a strong background in math and science. Try to take math classes through Trigonometry and science classes through Physics.

You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Blueprint Reading
- Computer Applications
- Computer-Assisted Design (CAD)
- Computer Science
- Drafting
- Electronics

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and groups that may be available in your high school or community can be found at http://www.careerkokua.org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Preparation

To work as an electronics engineering technologist, you must:

- have a high school diploma or GED;
- complete at least an associate degree in engineering technology;
- have practical, hands-on skills;
- have good math skills; and
- be creative.

EDUCATION AFTER HIGH SCHOOL

Most people prepare for this occupation by getting an associate degree (usually an associate's of applied science, or an AAS). Many schools offer two-year programs in engineering technology. You can also get a four-year degree in engineering technology from a university.

Some vocational schools offer electronics engineering technology programs. However, the kind and quality of these programs varies greatly. Carefully select your program. Make sure the school has the type of training you want, up-to-date equipment, and qualified instructors. Check with employers to see which schools they prefer. In addition, ask the schools for the names of employers where they have placed graduates.

Training programs approved by the Accreditation Board for Engineering and Technology (ABET) meet standards set by the industry. Graduating from an ABET accredited program can give you an advantage with employers.

Pre-engineering programs are not the same as technology programs. Pre-engineering programs stress classroom theory. In contrast, engineering technology programs stress hands-on training.

Related Educational Programs

- Apprenticeship
- Electrical/Electronics Technologies
- Engineering
- Engineering Technologies

WORK EXPERIENCE

Working in jobs that give you practical experience is good background for this occupation. For instance, repairing, installing, or assembling electronic devices is good experience for this occupation.

ON-THE-JOB TRAINING

As a new technologist, you perform routine tasks while closely supervised by an experienced technologist or engineer. As you gain experience, you work on tasks that are more difficult. Training may last up to a year.

Hiring Practices

Employers look for electronics engineering technologists who have at least a two-year degree in electronic engineering technology. Employers may not require applicants to be certified. However, those who are certified may have a competitive edge over other applicants.

Employers look for applicants with strong technical skills. Good communication skills are very important because technologists work with engineers and other team members. An interest in math and science is also important.

Advancement Opportunities

Electronics engineering technologists usually begin by doing routine duties. They work under the close supervision of experienced technologists or engineers. As they gain experience, technologists are given more difficult assignments and have less supervision. Engineering technologists with leadership skills may advance to supervisor positions. Keeping their skills current through continuing education classes helps technologists to advance.

With additional education, technologists can become engineers.

Additional Sources of Information

- Hawai'i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai'i Career Information Delivery System, www.careerkokua.org

Energy Auditors

At a Glance

- Help clients determine ways to cut their energy use and increase efficiency
- Work with people throughout the day
- Stand for long periods of time
- May be certified
- Are knowledgeable about construction
- Earn $58,340 per year (Hawai'i median)

Overview

Energy auditors evaluate energy use patterns. They look at both home and commercial buildings, and recommend ways buildings can use less energy.

Energy auditors first appeared in the 1970s as a result of the energy crisis. The high cost of energy forced people to be more conscious of their energy use. As awareness of global warming and climate change increases, people are again paying more attention to their energy use. As a result, the demand for energy auditors is growing.

Energy auditors perform many types of audits. Some are small audits of homes and offices, while others are large, such as those of schools or industrial complexes. The amount of detail on the audit also varies. Some are in-depth and take more time and expertise, while others are quick, walk-through audits.

Home energy auditors start by looking at the outside characteristics of a home, such as its size, the number of windows and doors, if there are sky lights, and the type of siding or exterior. Next they look at the patterns of the people who live there. They ask questions such as, "Are the people there during the day?" "Is there a room that never gets used?" "What source of heat is used during the winter?" Next the auditor does a room-by-room analysis. The same process is used when inspecting a non-residential building, only in this case they look for patterns such as how many people work in the building and what hours it is unoccupied.

Energy auditors need to be familiar with the different types of tests they conduct during the audit, such as the blower door test and a thermographic scan. Energy auditors also analyze the client's utility bills (water and electricity) for the previous year. After the audit, auditors write a report that describes the customer's energy use patterns and offers suggestions for ways to use less energy. Energy auditors use special software to develop these recommendations.

Specific Work Activities

The following list of occupational tasks is specific to energy auditors.

- Identify energy saving measures.
- Prepare reports of energy analysis results and recommendations for energy cost savings.
- Collect and analyze data related to energy use.
- Inspect and evaluate building exteriors, mechanical systems, and electrical wiring to determine how much energy each uses.
- Perform tests to locate air leaks.
- Educate customers on energy efficiency. Answer questions related to household energy use.
- Calculate potential energy use savings, using knowledge of engineering, construction, and energy use.
- Prepare information on home energy improvements, such as attic insulation, new or improved windows, and upgrades to heating systems.
- Recommend alternative energy sources, where applicable.
- Determine exact energy consumption to compare improvements to.
- Analyze energy bills to gather historical data.
- Use measuring devices such as data loggers, light meters, watt meters, and thermometers.

- May oversee the installation of new equipment and devices, such as water heaters, insulation, or windows.

Common Work Activities

Energy auditors perform the following list of tasks, but the tasks are common to many occupations.

- Inspect equipment, structures, or materials.
- Get information needed to do the job.
- Process information.
- Use computers.
- Make decisions and solve problems.
- Document and record information.
- Evaluate information against standards.
- Explain the meaning of information to others.
- Communicate with people from outside the organization.
- Update and use job-related knowledge.
- Analyze data or information.
- Identify objects, actions, and events.
- Communicate with supervisors, peers, or subordinates.
- Estimate sizes, quantities, time, cost, or materials needed.
- Perform activities that use the whole body.
- Provide advice and consultation to others.
- Perform administrative tasks.
- Convince others to buy goods or change their minds or actions.
- Organize, plan, and prioritize work.
- Monitor events, materials, and surroundings.

Related Occupations

This occupation is part of the **Architecture and Construction** cluster of occupations.

Related occupations include:
- Architects
- Carpenters
- Construction and Building Inspectors
- Electricians
- Glaziers
- Roofers

Hawai'i Career Pathways:
- Industrial & Engineering Technology

Related O*NET Specialties:
- Energy Auditors

Skills and Abilities

Energy auditors need to:

COMMUNICATE

- Understand spoken and written information.
- Express ideas clearly when speaking or writing.

REASON AND PROBLEM SOLVE

- Notice when something is wrong or is likely to go wrong.
- Use reasoning to discover answers to problems.
- Develop rules or follow guidelines when arranging items.
- Combine several pieces of information and draw conclusions.
- Think of original, unusual, or creative ways to solve problems.

USE MATH AND SCIENCE

- Choose a mathematical method or formula to solve problems.

PERCEIVE AND VISUALIZE

- Identify a pattern (a figure, object, word, or sound) that is hidden in distracting material.
- Quickly and accurately compare letters, numbers, objects, pictures, or patterns.

Working Conditions

In a typical work setting, energy auditors:

INTERPERSONAL RELATIONSHIPS

- Have a medium level of contact with others during the day. They interact with clients, but also spend time alone analyzing data.

- Communicate daily by e-mail, telephone, and in person. They also write letters, memo, and reports on a regular basis.
- Are somewhat responsible for work outcomes and the work done by others.
- Sometimes work as part of a team.

PHYSICAL WORK CONDITIONS

- Frequently must get into awkward positions to reach cramped work spaces.
- Work both indoors and outdoors when performing audits.
- Are often exposed to hot or cold temperatures, depending on the weather.
- Are sometimes exposed to extremely bright sunlight when working outdoors.
- May sometimes wear protective or safety gear, such as hard hats, when performing an audit.
- Are sometimes exposed to contaminants.
- Occasionally are exposed to high places, such as atop scaffolding, during an audit.
- Typically work in environments where they must test heating and air conditioning. Therefore, temperatures fluctuate.
- Often travel to work sites in a car, truck, or van.

WORK PERFORMANCE

- Must be very exact and accurate when analyzing data and submitting recommendations.
- Repeat the same mental and physical tasks during audits.
- Usually set their daily tasks and goals for the day, but they may check in with a supervisor first.
- Often make decisions without consulting another first. These decisions impact their company's reputation and their client's energy bills.

HOURS / TRAVEL

- Usually work a regular work week. May work overtime to meet deadlines.

Physical Demands

Energy auditors frequently:

- Stand for long periods of time.
- Use their hands to handle, control, or feel objects, tools, or controls.

It is important for energy auditors to be able to:

- See details of objects that are less than a few feet away.
- Understand the speech of another person.
- Speak clearly so listeners can understand.
- Hold the arm and hand in one position or hold the hand steady while moving the arm.
- Make quick, precise adjustments to machine controls.
- Use fingers to grasp, move, or assemble very small objects.

It is not as important, but still necessary, for energy auditors to be able to:

- Move two or more limbs together (for example, two arms, two legs, or one leg and one arm) while remaining in place.
- See details of objects that are more than a few feet away.
- Bend, stretch, twist, or reach out.
- Use one or two hands to grasp, move, or assemble objects.
- Use stomach and lower back muscles to support the body for long periods without getting tired.
- Hear sounds and recognize the difference between them.
- See differences between colors, shades, and brightness.
- Keep or regain the body's balance or stay upright when in an unstable position.
- Be physically active and use muscles for long periods without getting tired or out of breath.
- Use muscles to lift, push, pull, or carry heavy objects.
- Adjust body movements or equipment controls to keep pace with speed changes of moving objects.
- Choose quickly and correctly among various movements when responding to different signals.
- Coordinate movement of several parts of the body, such as arms and legs, while the body is moving.
- Focus on one source of sound and ignore others.
- See objects in very low light.

- React quickly using hands, fingers, or feet.

Knowledge

Energy auditors need knowledge in the following areas:

- Building and Construction: Knowledge of constructing buildings and other structures.
- Customer and Personal Service: Knowledge of providing special services to customers based on their needs.
- English Language: Knowledge of the meaning, spelling, and use of the English language.
- Mathematics: Knowledge of the rules and uses of numbers. Areas of knowledge include arithmetic, algebra, geometry, and statistics.
- Mechanical: Knowledge of designing, using, and repairing machines and tools.
- Sales and Marketing: Knowledge of advertising and selling products and services.
- Clerical: Knowledge of general office work such as filing and recording information.
- Physics: Knowledge of the features and rules of matter and energy. Areas of knowledge include air, water, light, heat, weather, and other natural events.
- Design: Knowledge of making and using plans, blueprints, drawings, and models.
- Computers and Electronics: Knowledge of computer hardware and software.
- Engineering and Technology: Knowledge of how to build machines, buildings, and other things. Also includes knowledge of how to use computers, machines, and tools to do work more usefully.

Interests

Energy auditors are people who tend to:

- Consider support from their employer important. They like to be treated fairly and have supervisors who will back them up. They prefer jobs where they are trained well.
- Consider independence important. They like to make decisions and try out ideas on their own. They prefer jobs where they can plan their work with little supervision.
- Consider achievement important. They like to see the results of their work and to use their strongest abilities. They like to get a feeling of accomplishment from their work.
- Consider recognition important. They like to work in jobs which have opportunities for them to advance, be recognized for their work, and direct and instruct others. They usually prefer jobs in which they are looked up to by others.
- Consider good working conditions important. They like jobs offering steady employment and good pay. They want employment that fits their individual work style. They may prefer doing a variety of tasks, working alone, or being busy all the time.
- Have conventional interests. They like work activities that follow set procedures, routines, and standards. They like to work with data and detail. They prefer working where there is a clear line of authority to follow.
- Have enterprising interests. They like work activities that involve starting up and carrying out projects, especially in business. They like to lead and persuade others, make decisions, and take risks for profit.

OCCUPATIONAL INTEREST CODES

- CE

Wages

Wages vary by employer and area of the country. Wages may also vary by the type of audits being performed. Energy auditors who perform smaller audits (such as an individual home) may earn less than auditors who perform audits of larger buildings and structures.

Full-time energy auditors may receive benefits. Typical benefits include health insurance, sick leave, and paid vacation. Those who work for small companies may need to provide their own insurance.

Location	Pay Period	25%	Median	75%
Hawai'i	Hourly	$19.73	$28.05	$37.49
	Yearly	$41,030	$58,340	$77,980
Honolulu	Hourly	$19.74	$28.27	$38.07
	Yearly	$41,060	$58,800	$79,180
United States	Hourly	$21.27	$29.14	$39.05
	Yearly	$44,240	$60,610	$81,220

Outlook

In Hawai'i, outlook information is not available specifically for energy auditors. However, they are included in a larger group of "business operations specialists, all other. Slower than average employment growth is expected for workers in this group through 2018.

Nationally, the number of jobs for workers in this group is expected to grow as fast as the average through 2018.

The table below provides information about the number of workers in this occupation in various regions. It also provides information about the expected growth rate and future job openings.

	Employment		Employment Change	
	2008	2018	Number	Percent
National	1,091,100	1,217,000	125,900	11.5
State	5,810	6,050	240	4.1

EMPLOYMENT

Major employers:
- Federal, state, and local government agencies

OUTLOOK

People are becoming more concerned about energy conservation. This will increase the demand for buildings that are more energy efficient. Energy auditors will be needed to perform audits on new buildings as well as existing buildings.

In addition, tax incentives will create more job opportunities for energy auditors. These incentives make it more affordable for individuals and businesses to make their buildings energy efficient.

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later. If you attend a private school, check with your school counselor for graduation requirements.

You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Algebra
- Blueprint Reading
- Building Maintenance
- Computer Applications
- Electricity
- Physics
- Technical Writing

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the

courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and groups that may be available in your high school or community can be found at http://www.careerkokua.org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Preparation

To work as an energy auditor, you must:

- have a high school diploma or GED;
- complete college course work or have work experience;
- complete on-the-job training;
- have excellent communication skills; and
- be detail oriented.

Education After High School

Energy auditor training programs vary greatly. They range in length from two-year associate degree programs to more in-depth four-year programs. Most energy auditors take courses to become a Certified Energy Auditor. If you wish to own your own business, consider taking business classes as well.

In these programs, you study energy management, basic building principles, learn how to evaluate energy use patterns, and understand HVAC&R (heating, ventilation, air conditioning, and refrigeration technology) systems. You also take courses in algebra, English, and physics.

Work Experience

Early in your career, you may spend several years gaining work experience before getting a job as an energy auditor. Working alongside or in support of another energy auditor allows you to have an idea of the day-to-day responsibilities associated with the occupation.

On-the-Job Training

Most beginning energy auditors learn additional skills on the job from an experienced worker. You begin as a helper and do basic tasks. During training, you learn:

- inspection techniques;
- data analysis;
- equipment use; and
- computer software programs.

Related Educational Programs

- Apprenticeship
- Construction Trades
- Drafting/Design Technologies
- Electrical/Electronics Technologies
- Engineering
- Engineering Technologies
- Environmental Control Technologies
- Mathematics
- Other Mechanics and Repairers

Licensing / Certification / Designation / Registration

The state requires energy auditors to be licensed when they are contractors.

Hiring Practices

Employers look for energy auditors who have at least a two-year degree in this field. Those who are Certified Energy Auditors may have a competitive edge over other applicants.

Employers look for applicants with excellent communication skills. Auditors must communicate with homeowners and businesspeople about their energy use and needs, so the ability to write and speak well is important. Those who are organized and detail-oriented are desirable employees as well.

Advancement Opportunities

Energy auditors often start out by performing smaller audits (such as an individual home) and work their way up to performing audits of larger buildings and structures. Those with a bachelor's degree or significant work experience may advance more quickly to a supervisory role. In addition, those with business skills and education may open their own energy auditing and consulting businesses.

Additional Sources of Information

- Hawai'i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai'i Career Information Delivery System, www.careerkokua.org

Energy Engineers

At a Glance

- Work in the construction field
- Seek ways to improve energy efficiency or cut energy use
- Have at least a bachelor's degree
- May specialize in one area, such as heating and cooling
- Review designs and plans
- Earn $82,920 per year (Hawai'i median)

Overview

Energy engineers design, develop, and evaluate energy-related projects and programs. They study ways to reduce energy costs or improve energy efficiency.

Energy engineers seek ways to use energy most efficiently—and hopefully use less energy in the long run. For example, an energy engineer may help a business set up a good daylighting system. This is when natural light is used (as much as possible) to light the interior of a building, rather than use electric light. Or, an energy engineer can design a better, more efficient heating and cooling system for an office building or a home.

Energy engineers need to have a good grasp of math and science. They also need to be detail-oriented, analyzing plans, systems, and operations to see how energy is used. They may focus on an existing system to identify ways to change and improve it. Energy engineers also specialize in designing, implementing, and testing new designs and systems that use energy in efficient and creative ways.

Engineers review energy use, costs, and measures to conserve or reduce energy consumption. They may visit job and construction sites to inspect systems themselves. If they are part of a new design or building, they may be part of a team that monitors budgets, specifications, and legal requirements. They often are part of the group who decides on a final design or system for energy use. Energy engineers seek ways to get more out of our energy resources by using less.

Specific Work Activities

The following list of occupational tasks is specific to energy engineers.

- Identify energy savings opportunities and make recommendations to achieve more energy efficient operation.
- Manage the development, design, or construction of energy conservation projects. Monitor budgets, timelines, laws, and project specifications.
- Conduct energy audits to evaluate energy use, costs, or conservation measures.
- Monitor and analyze energy consumption.
- Perform energy modeling, measurement, and verification.
- Oversee design or construction aspects related to energy such as energy engineering, energy management, and sustainable design.
- Conduct jobsite observations, field inspections, or sub-metering to collect data for energy conservation analyses.
- Review architectural, mechanical, or electrical plans and specifications to evaluate energy efficiency. Determine feasibility of designs.
- Inspect or monitor energy systems including heating, ventilation and air conditioning (HVAC). Inspect or monitor lighting systems to determine energy use or potential energy savings.
- Evaluate construction design such as detail and assembly drawings, design calculations, system layouts and sketches, or specifications.

Common Work Activities

Energy engineers perform the following list of tasks, but the tasks are common to many occupations.

- Use computers.
- Get information needed to do the job.
- Communicate with supervisors, peers, or subordinates.
- Analyze data or information.
- Make decisions and solve problems.
- Communicate with people from outside the organization.
- Process information.
- Update and use job-related knowledge.
- Estimate sizes, quantities, time, cost, or materials needed.
- Explain the meaning of information to others.
- Identify objects, actions and events.
- Provide advice and consultation to others.
- Establish and maintain relationships.
- Monitor events, materials, and surroundings.
- Evaluate information against standards.
- Think creatively.
- Organize, plan, and prioritize work.
- Develop and build teams.
- Judge the value of objects, services, or people.
- Document and record information.

Related Occupations

This occupation is part of the **Science, Technology, Engineering, and Mathematics** cluster of occupations.

Related occupations include:
- Electrical and Electronics Engineers
- Fuel Cell Engineers
- Fuel Cell Technicians
- Manufacturing Engineers
- Renewable Energy Engineers
- Wind Energy Engineers

Hawai'i Career Pathways:
- Industrial & Engineering Technology

Related O*NET Specialties:
- Energy Engineers

Skills and Abilities

Energy engineers need to:

COMMUNICATE

- Read and understand written information.
- Express ideas clearly when speaking and writing.

REASON AND PROBLEM SOLVE

- Use reasoning to discover answers to problems.
- Combine several pieces of information and draw conclusions.
- Notice when something is wrong or is likely to go wrong.
- Develop rules or follow guidelines when that group items in various ways.
- Concentrate and not be distracted while performing a task.
- Think of new ideas or original and creative ways to solve problems.

USE MATH AND SCIENCE

- Choose a mathematical method or formula to solve problems.
- Add, subtract, multiply, and divide quickly and correctly.

MANAGE ONESELF, PEOPLE, TIME, AND THINGS

- Go back and forth between two or more activities or sources of information without becoming confused.

PERCEIVE AND VISUALIZE

- Identify a pattern (a figure, object, word, or sound) that is hidden in distracting material.
- Imagine how something will look if it is moved around or its parts are rearranged.
- Quickly and accurately compare letters, numbers, objects, pictures, or patterns.

Working Conditions

In a typical work setting, energy engineers:

INTERPERSONAL RELATIONSHIPS

- Have a moderately high level of social interaction. They spend most of their time talking to other engineers, managers, and clients.
- Communicate with people daily by telephone, e-mail, and in person.
- Write letters and memos on a weekly basis.
- Work as part of a project team.
- Have limited responsibility for the work done by others.
- Are somewhat responsible for the health and safety of others.

PHYSICAL WORK CONDITIONS

- Usually work indoors. Occasionally work outdoors, especially when visiting construction sites.
- Occasionally wear protective or safety attire.
- Often travel to and from work sites in an enclosed vehicle, such as a truck, car, or van.

WORK PERFORMANCE

- Must be very exact and accurate. Errors can delay construction projects.
- Rarely consult a supervisor before making a decisions or setting tasks and goals.
- Meet strict daily and weekly deadlines. This makes the work atmosphere somewhat competitive.
- Often make decisions that strongly impact coworkers and their company.
- Repeat the same physical and mental tasks.

HOURS / TRAVEL

- Often must meet deadlines.
- Usually work a standard work week, but often work overtime.

Physical Demands

Energy engineers frequently:

- Sit for long periods of time.

It is important for energy engineers to be able to:

- Speak clearly so listeners can understand.
- See details of objects that are less than a few feet away.
- Understand the speech of another person.

It is not as important, but still necessary, for energy engineers to be able to:

- See details of objects that are more than a few feet away.
- Use fingers to grasp, move, or assemble very small objects.
- Focus on one source of sound and ignore others.
- Determine the distance between objects.
- See differences between colors, shades, and brightness.
- Hear sounds and recognize the difference between them.
- Make quick, precise adjustments to machine controls.

Knowledge

Energy engineers need knowledge in the following areas:

- Engineering and Technology: Knowledge of how to build machines, buildings, and other things. Also includes knowledge of how to use computers, machines, and tools to do work more usefully.
- Mathematics: Knowledge of the rules and uses of numbers. Areas of knowledge include arithmetic, algebra, geometry, and statistics.
- English Language: Knowledge of the meaning, spelling, and use of the English language.
- Building and Construction: Knowledge of constructing buildings and other structures.
- Physics: Knowledge of the features and rules of matter and energy. Areas of knowledge include air, water, light, heat, weather, and other natural events.
- Design: Knowledge of making and using plans, blueprints, drawings, and models.
- Mechanical: Knowledge of designing, using, and repairing machines and tools.

- Administration and Management: Knowledge of managing the operations of a business, company, or group.
- Economics and Accounting: Knowledge of producing, supplying, and using goods and services. Also includes knowledge of the methods for keeping business records.
- Computers and Electronics: Knowledge of computer hardware and software.
- Customer and Personal Service: Knowledge of providing special services to customers based on their needs.
- Law, Government, and Jurisprudence: Knowledge of laws, rules, court procedures, and the political process.

Interests

Energy engineers are people who tend to:

- Consider good working conditions important. They like jobs offering steady employment and good pay. They want employment that fits their individual work style. They may prefer doing a variety of tasks, working alone, or being busy all the time.
- Consider achievement important. They like to see the results of their work and to use their strongest abilities. They like to get a feeling of accomplishment from their work.
- Consider independence important. They like to make decisions and try out ideas on their own. They prefer jobs where they can plan their work with little supervision.
- Consider recognition important. They like to work in jobs which have opportunities for them to advance, be recognized for their work, and direct and instruct others. They usually prefer jobs in which they are looked up to by others.
- Consider support from their employer important. They like to be treated fairly and have supervisors who will back them up. They prefer jobs where they are trained well.
- Have investigative interests. They like work activities that have to do with ideas and thinking. They like to search for facts and figure out solutions to problems mentally.
- Have realistic interests. They like work activities that include practical, hands-on problems and solutions. They like to work with plants, animals, and physical materials such as wood, tools, and machinery. They often prefer to work outside.

Occupational Interest Codes

- IR

Wages

Wages vary by employer and area of the country. The engineer's level of training, experience, and responsibility also affect wages.

Energy engineers who work full time usually receive benefits. Typical benefits include sick leave, paid vacation, and health insurance. Some employers also provide a retirement plan.

Location	Pay Period	25%	Median	75%
Hawai'i	Hourly	$30.51	$39.86	$45.89
	Yearly	$63,460	$82,920	$95,450
Honolulu	Hourly	$33.58	$40.55	$46.16
	Yearly	$69,850	$84,350	$96,010
United States	Hourly	$32.22	$43.06	$54.33
	Yearly	$67,030	$89,560	$113,010

Outlook

In Hawai'i, outlook information is not available specifcally for energy engineers. However, they are included in a larger group of "engineers, all other." Little change in employment is expected for workers in this group. through 2018.

Nationally, the number of workers in this group is expected to grow slower than average through 2018.

The table below provides information about the number of workers in this occupation in various regions. It also

provides information about the expected growth rate and future job openings.

EMPLOYMENT

Major employers:
- Engineering firms
- Federal, state, and local government agencies

OUTLOOK

Much of the job growth for energy engineers will be due to the growing green sector of the economy. Energy engineers will be needed to help design more energy efficient systems. Opportunities will be best for engineers with strong technical, computing, and communication skills.

Job openings will occur each year as workers leave this occupation or retire.

	Employment		Employment Change	
	2008	2018	Number	Percent
National	183,200	195,400	12,200	6.7
State	730	730	0	0.0

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later. If you attend a private school, check with your school counselor for graduation requirements. Energy engineers use math and science frequently. Try to take math classes through Trigonometry and science classes through Physics.

You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Blueprint Reading
- Computer Applications
- Computer-Assisted Design (CAD)
- Computer Science
- Construction
- Drafting

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and groups that may be available in your high school or community can be found at http://www.careerkokua.org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Preparation

To work as an energy engineer, you must:

- have a high school diploma or GED;
- complete at least a bachelor's degree; and
- have strong technical and communication skills.

EDUCATION AFTER HIGH SCHOOL

Energy engineers need at least a bachelor's degree in engineering. More universities are developing engineering programs specifically in energy engineering, but it is possible to get a degree in civil, mechanical, electrical or another type of engineering and still work in this occupation. In addition, some colleges and universities also offer engineering programs with an emphasis on environmental systems and design. Engineering programs take four to five years to complete.

Some schools offer certificate programs in energy engineering. These programs are designed for those who already have a bachelor's degree in engineering.

WORK EXPERIENCE

Consider participating in an internship with an engineering firm while you are in college. An internship offers you a chance to apply what you have learned in the classroom to a work situation. It also allows you to build skills and make contacts with people in the field.

ON-THE-JOB TRAINING

It is common for newly hired energy engineers to receive some on-the-job training. This varies by employer, and can last anywhere from a month to a year.

Related Educational Programs

- Electrical/Electronics Technologies
- Engineering
- Engineering Technologies

Hiring Practices

Most employers require that energy engineers have at least a bachelor's degree in engineering. Many employers will require a master's degree. Employers also look for people with strong communication, computer, and technical skills. Certification or licensing may also be required.

Licensing / Certification / Designation / Registration

In Hawai'i, engineers (except those employed by the federal government) whose work involves the safety or health of the public must be licensed by the Hawai'i board of professional engineers, architects, surveyors, and landscape architects. In Hawaii, licenses are offered in seven disciplines of engineering which include agriculture, chemical, civil, electrical, industrial, mechanical, and structural. Licensure requires meeting educational and experience requirements and paying fees.

Advancement Opportunities

Energy engineers advance by becoming licensed. After graduation, engineers usually take an exam on the fundamentals of engineering. Next, energy engineers work under the supervision of a licensed professional engineer for a period of years that is determined by the state board of examiners. Once they have met the work experience requirements, they can take another exam to become a professional engineer.

Once energy engineers pass the professional exam and get licensed, they have many options for advancement. They may be given more complex projects and be assigned as the lead engineer. They may move into management positions. Professional energy engineers can also start their own consulting firms.

Additional Sources of Information

- Hawai'i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai'i Career Information Delivery System, www.careerkokua.org

Fuel Cell Engineers

Overview

Fuel cell engineers design and test fuel cell technology to generate power. They use this technology to power everyday items as well as large buildings.

Fuel cell engineers are the people who develop fuel cell technology. While many people have heard of automobiles run by fuel cells, most of us don't know that things such as cell phones or space heaters can also use fuel cells.

When designing fuel cells for a new application, engineers usually work in teams to come up with an overall concept. Some engineers focus only on one part of a fuel cell, such as the assembly, stacks, or other components. They develop prototypes of the technology, often using complicated software. Engineers must decide the purpose of the particular fuel cell, under what conditions it should work, how long it should last, and other criteria. Then, they must determine the best materials for the fuel cell and the best way to test it.

Testing and analysis is a large part of developing a fuel cell project. Engineers use sophisticated instruments and diagnostics to see how well a fuel cell works. Often they use computer models to simulate how a fuel cell works before they test a prototype. In all testing, engineers look to see how much energy a fuel cell puts out, how emissions can be lowered even further, and how to make the fuel cell even more efficient. In the early stages of testing, it is common for prototypes to fail or perform poorly. Engineers analyze several factors to see why the fuel cell didn't perform and make adjustments. Once adjustments are made, engineers repeat the testing process.

In some cases, engineers work to integrate fuel cells with hybrid engines and motors. This means they must have knowledge of combustion engines as well as fuel cell technology.

Fuel cell engineers must have advanced skills in higher-level math and science. They must be proficient in using complicated computer software. They must also be both detail-minded and creative. It is expected that this career will grow quickly as the focus on renewable energy grows. Engineers in this field must constantly read literature and attend conferences to keep up with developments in the field.

Related Occupations

This occupation is part of the **Science, Technology, Engineering, and Mathematics** cluster of occupations.

Related occupations include:
- Chemical Engineers
- Electrical and Electronics Engineers
- Energy Engineers
- Fuel Cell Technicians
- Mechanical Engineers
- Renewable Energy Engineers

Hawai'i Career Pathways:
- Industrial & Engineering Technology

Outlook

Analysts expect that the fuel cell industry will continue to grow rapidly. This is due to government incentives and increased consumer interest.

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/

Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later. If you attend a private school, check with your school counselor for graduation requirements.

You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Blueprint Reading
- Computer Applications
- Computer Science
- Electronics
- Introduction to Mechanics

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and groups that may be available in your high school or community can be found at http://www.careerkokua.org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Preparation

To work as a fuel cell engineer, you must:

- have a high school diploma or GED;
- have a college degree in chemical or mechanical engineering;
- be curious and detail-oriented;
- have strong analytical skills; and
- be creative.

EDUCATION AFTER HIGH SCHOOL

Most students prepare for this field by earning a bachelor's degree in chemical or mechanical engineering. Many four-year colleges and universities offer these programs of study. You may need between four and five years to complete one of these programs. Some two-year colleges have agreements with the engineering departments at four-year schools. These agreements allow you to take your first two years of courses at the two-year college. Then you move to the university for the last two years. Some liberal arts schools have similar programs to prepare you for engineering schools.

Right now there are very few dedicated fuel cell engineering programs of study. As the field grows, it is likely that more courses will be offered to provide college-level training in this area.

Some jobs require a master's or doctoral degree (Ph.D.). For instance, if you are interested in teaching fuel cell engineering at a college you need a Ph.D. Also, many student engineers go to graduate school to specialize or work in advanced positions.

WORK EXPERIENCE

It is helpful to have technical or related engineering work experience. Working as an intern during college is a great way to gain experience.

ON-THE-JOB TRAINING

New workers often learn additional skills on the job. The length of training may vary.

Related Educational Programs

- Engineering
- Engineering Technologies

Licensing / Certification / Designation / Registration

In Hawai‘i, engineers (except those employed by the federal governement) whose work involves the safety or health of the public must be licensed by the Hawai‘i board of professional engineers, architects, surveyors, and landscape architects. In Hawai‘i, licenses are offered in seven disciplines of engineering which include agricultural, chemical, civil, electrical, industrial, mechanical, and structural. Licensure requires meeting educational and experience requirements, passing an exam, and paying fees.

Additional Sources of Information

- Hawai‘i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai‘i Career Information Delivery System, www.careerkokua.org

Fuel Cell Technicians

Overview

Fuel cell technicians install, operate, and maintain fuel cell systems.

Fuel cell technology is part of the larger field of using hydrogen as an energy source.

Fuel cell technicians play a key part in this growing field. Where engineers spend a lot of time designing fuel cell technology, technicians are more hands-on. They often work with engineers to build fuel cell prototypes. Using complicated equipment, they follow specifications to assemble the fuel cell. Then, using a variety of electronic tools and devices, they test the fuel cell.

To do this, first they check to make sure it is operational. Technicians check to make sure that the energy the fuel cell generates meets expectations. They also monitor emissions. Fuel cells should generate low to zero emissions. When things go wrong, they report this to engineers and may make suggestions for modifications. An important part of the testing process is documenting every step and every result. Therefore, technicians must have an eye for detail. They must also be proficient using computers.

Fuel cell technicians work in the field by installing fuel cells in vehicles and structures. As in testing, they follow plans and specifications. They make adjustments where necessary. They also perform repairs where needed. Technicians often build and test cells in electrical and power plant systems.

Technicians maintain testing equipment to keep it functioning well. They troubleshoot equipment when it is malfunctioning.

Related Occupations

This occupation is part of the **Science, Technology, Engineering, and Mathematics** cluster of occupations.

Related occupations include:
- Electronics Engineering Technologists
- Energy Engineers
- Engineering Technicians
- Fuel Cell Engineers
- Renewable Energy Engineers

Hawai‘i Career Pathways:
- Industrial & Engineering Technology

Outlook

Analysts expect that the fuel cell industry will continue to grow rapidly. This is due to government incentives and increased consumer interest.

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later. If you attend a private school, check with your school counselor for graduation requirements.

You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are

available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Blueprint Reading
- Computer Applications
- Computer Science
- Drafting
- Geology
- Keyboarding
- Natural Resources Management
- Probability and Statistics

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and groups that may be available in your high school or community can be found at http://www.careerkokua.org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Preparation

To work as a fuel cell technician, you must:

- have a high school diploma or GED;
- have at least an associate degree in environmental engineering technology or a related field;
- have practical, hands-on skills;
- have good math skills; and
- be creative.

EDUCATION AFTER HIGH SCHOOL

Most people prepare for this occupation by getting an associate degree. Many schools offer two-year programs in environmental, chemical, or mechanical engineering technology. A few schools are beginning to offer fuel cell technology programs. As an undergraduate student you study chemistry, fundamentals of engineering, and environmental science.

English courses are helpful for writing research and safety reports. Take technical, and oral and interpersonal communication courses to learn how to interpret technical materials and keep scientific report records. Algebra and statistics courses can help you solve mathematical problems.

Many vocational schools offer engineering technology programs. However, the kind and quality of these programs varies greatly. Carefully select your program. Check with employers to see which schools they prefer. In addition, ask the schools for the names of employers where they have placed graduates. Make sure the school has the type of training you want, up-to-date equipment, and qualified instructors. In addition, make sure the school's program offers courses related to your engineering specialty.

Training programs approved by the Accreditation Board for Engineering and Technology (ABET) meet standards set by the industry. Graduating from an ABET accredited program can give you an advantage with employers. Pre-engineering programs are not the same as technology programs. Pre-engineering programs stress classroom theory. In contrast, engineering technology programs stress hands-on training.

WORK EXPERIENCE

Working in jobs that give you practical experience in fuel cell, mechanical, or chemical engineering technology is good background for this occupation.

Many engineering companies have their own testing labs. They often need extra help during the summer when construction activities are at a peak. Getting a summer job at an "in house" laboratory is a good way to gain experience and make contacts.

ON-THE-JOB TRAINING

As a new technician, you perform routine tasks while closely supervised by an experienced technician or engineer. As you gain experience, you work on tasks that are more difficult. Training may last up to a year.

Some fuel cell technicians may also receive additional training in the use of special equipment.

Related Educational Programs

- Apprenticeship
- Engineering Technologies

Additional Sources of Information

- Hawai'i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai'i Career Information Delivery System, www.careerkokua.org

Geospatial Information Scientists and Technologists

At a Glance

- Spend a lot of time on computers
- Most have a bachelor's degree
- Work with Geographic Information Systems (GIS) to produce maps and analyze data
- Often work in teams
- Earn $79,420 per year (Hawai'i median)

Overview

Geospatial information scientists and technologists use Geographic Information Systems (GIS) and other software. They study how to best use physical space.

Geospatial information scientists and technologists measure and study how people use the space around them. This is related to geography—the study of the earth's features, climate, resources, and population. For many people, the field of geography equals the study of maps. Maps are an important form of geospatial information, but there are many other types of data that have nothing to do with getting from point A to point B.

For example, they might examine the best place to build a new school, based on an area's population of school-age children and how many kids are expected to be born or move into an area. Or, they might analyze the flow of traffic to see where to build a new bridge.

Geospatial information scientists and technologists use GIS technology to produce and analyze data. They also use Global Positioning Systems (GPS) and aerial and remote sensing technology. In addition to being knowledgeable in science, they must be good at using sophisticated computer software, including programming and data analysis. They must also be good at reporting the results of GIS maps and studies in a way that is clear to non-technical people.

Geospatial information scientists and technologists can use their GIS and GPS skills in a variety of fields. Examples include agriculture, construction, energy, natural resources, and regional planning.

This occupation has the potential to be part of the growing green economy because of its focus on efficiency and sustainability. Because it has such wide applications, it can be used to help different industries find the best ways to use and protect the earth's natural resources.

Geospatial information scientists and technologists must also be good at working with clients. Often, their work will be project-based according to a client's needs. Therefore, they must be skilled at following budgets and schedules and communicating effectively in meetings.

Specific Work Activities

The following list of occupational tasks is specific to geospatial information scientists and technologists.

- Produce data, maps, tables, or reports using Geographic Information Systems (GIS) technology.
- Coordinate GIS projects, including reports and meetings with clients as well as schedules and budgets.
- Provide technical expertise in GIS technology to clients or users.
- Create, analyze, report, or transfer data using special software.
- Maintain existing systems. Research future changes to GIS systems.
- Provide technical support for GIS mapping software.
- Perform computer programming, data analysis, or software development for GIS.
- Lead, train, or supervise technicians or related staff in GIS.
- Collect or integrate GIS data, such as remote sensing and cartographic data, for inclusion in maps.

- Meet with clients to discuss topics such as technical specifications, solutions, and operational problems.

Common Work Activities

Geospatial information scientists and technologists perform the following list of tasks, but the tasks are common to many occupations.

- Use computers.
- Process information.
- Get information needed to do the job.
- Update and use job-related knowledge.
- Communicate with supervisors, peers, or subordinates.
- Analyze data or information.
- Make decisions and solve problems.
- Think creatively.
- Communicate with people from outside the organization.
- Identify objects, actions, and events.
- Organize, plan, and prioritize work.
- Document and record information.
- Explain the meaning of information to others.
- Establish and maintain relationships.
- Coordinate the work and activities of others.
- Provide advice and consultation to others.
- Develops goals and strategies.
- Teach others.
- Evaluate information against standards.
- Estimate sizes, quantities, time, cost, or materials needed.

Related Occupations

This occupation is part of the **Science, Technology, Engineering, and Mathematics** cluster of occupations.

Related occupations include:
- Cartographers and Photogrammetrists
- Geographic Information Systems Specialists
- Precision Agriculture Technicians
- Remote Sensing Scientists and Technologists
- Sociologists
- Surveying and Mapping Technicians
- Surveyors

Hawai'i Career Pathways:
- Industrial & Engineering Technology

Related O*NET Specialties:
- Geospatial information scientists and technologists

Skills and Abilities

Geospatial information scientists and technologists need to:

COMMUNICATE

- Read and understand written information.
- Express ideas clearly when speaking and writing.

REASON AND PROBLEM SOLVE

- Combine several pieces of information and draw conclusions.
- Develop rules or follow guidelines when arranging items.
- Notice when something is wrong or is likely to go wrong.
- Use reasoning to discover answers to problems.
- Concentrate and not be distracted while performing a task.
- Think of new ideas or original and creative ways to solve problems.

USE MATH AND SCIENCE

- Choose a mathematical method or formula to solve problems.

PERCEIVE AND VISUALIZE

- Identify a pattern (a figure, object, word, or sound) that is hidden in distracting material.
- Imagine how something will look if it is moved around or its parts are rearranged.
- Quickly and accurately compare letters, numbers, objects, pictures, or patterns.

Working Conditions

In a typical work setting, geospatial information scientists and technologists:

INTERPERSONAL RELATIONSHIPS

- Have a low to medium high level of social interaction. They spend time talking to other technologists, managers, and clients, but also spend time alone analyzing data.
- Communicate with people daily by telephone, e-mail, and in person.
- Are somewhat responsible for the work done by others.
- Write letters and memos on a weekly basis.
- Work as part of a project team.

PHYSICAL WORK CONDITIONS

- Almost always work indoors. May work outdoors on occasion.

WORK PERFORMANCE

- Must be very exact and accurate when analyzing data.
- Rarely consult a supervisor before making a decisions or setting tasks and goals.
- Meet strict daily and weekly deadlines. This makes the work atmosphere somewhat competitive.
- Often make decisions that strongly impact coworkers and their company.
- Repeat the same physical and mental tasks.

HOURS / TRAVEL

- Usually work a standard work week. They may work overtime to meet project deadlines.

Physical Demands

Geospatial information scientists and technologists frequently:

- Sit for long periods of time.
- Repeat the same movements.
- Use their hands to handle, control, or feel objects, tools, or controls.

It is important for geospatial information scientists and technologists to be able to:

- See details of objects that are less than a few feet away.
- Speak clearly so listeners can understand.
- Understand the speech of another person.
- Use fingers to grasp, move, or assemble very small objects.

It is not as important, but still necessary, for geospatial information scientists and technologists to be able to:

- See differences between colors, shades, and brightness.
- See details of objects that are more than a few feet away.
- Make quick, precise adjustments to machine controls.
- Hold the arm and hand in one position or hold the hand steady while moving the arm.
- Use one or two hands to grasp, move, or assemble objects.

Knowledge

Geospatial information scientists and technologists need knowledge in the following areas:

- Geography: Knowledge of land, sea, and air masses. Also includes knowledge of how to describe their location, features, and relationships.
- Computers and Electronics: Knowledge of computer hardware and software.
- English Language: Knowledge of the meaning, spelling, and use of the English language.
- Customer and Personal Service: Knowledge of providing special services to customers based on their needs.
- Mathematics: Knowledge of the rules and uses of numbers. Areas of knowledge include arithmetic, algebra, geometry, and statistics.
- Engineering and Technology: Knowledge of how to build machines, buildings, and other things. Also includes knowledge of how to use computers, machines, and tools to do work more usefully.

- Administration and Management: Knowledge of managing the operations of a business, company, or group.
- Design: Knowledge of making and using plans, blueprints, drawings, and models.
- Education and Training: Knowledge of teaching and the methods involved in learning and instruction.

Interests

Geospatial information scientists and technologists are people who tend to:

- Consider achievement important. They like to see the results of their work and to use their strongest abilities. They like to get a feeling of accomplishment from their work.
- Consider independence important. They like to make decisions and try out ideas on their own. They prefer jobs where they can plan their work with little supervision.
- Consider good working conditions important. They like jobs offering steady employment and good pay. They want employment that fits their individual work style. They may prefer doing a variety of tasks, working alone, or being busy all the time.
- Consider recognition important. They like to work in jobs which have opportunities for them to advance, be recognized for their work, and direct and instruct others. They usually prefer jobs in which they are looked up to by others.
- Consider relationships important. They like to work in a friendly, non-competitive environment. They like to do things for other people. They prefer jobs where they are not pressured to do things that go against their sense of right and wrong.
- Have investigative interests. They like work activities that have to do with ideas and thinking. They like to search for facts and figure out solutions to problems mentally.
- Have realistic interests. They like work activities that include practical, hands-on problems and solutions. They like to work with plants, animals, and physical materials such as wood, tools, and machinery. They often prefer to work outside.
- Have conventional interests. They like work activities that follow set procedures, routines, and standards. They like to work with data and detail. They prefer working where there is a clear line of authority to follow.

Occupational Interest Codes

- IRC

Wages

Wages vary by employer and area of the country. The individual's specialty and level of experience and responsibility also affect wages. Those who have supervisory duties usually earn higher wages.

Geospatial information scientists and technologists who work full time usually receive benefits. Typical benefits include sick leave, paid vacation, and health insurance. Some employers also provide a retirement plan.

Location	Pay Period	25%	Median	75%
Hawai'i	Hourly	$31.83	$38.19	$43.13
	Yearly	$66,210	$79,420	$89,710
Honolulu	Hourly	$31.75	$38.07	$43.03
	Yearly	$66,040	$79,180	$89,500
United States	Hourly	$28.11	$37.02	$46.58
	Yearly	$58,460	$77,010	$96,890

Outlook

In Hawai'i, outlook information is not available specifically for geospatial information scientists and technologists. However, they are part of a larger group of "computer specialists, all other." Slower than average employment growth is expected for workers in this group through 2018.

Nationally, the number of workers in this group is expected to grow faster than average through 2018.

The table below provides information about the number of workers in this occupation in various regions. It also

provides information about the expected growth rate and future job openings.

EMPLOYMENT

Major employers:
- Consulting firms
- Local, state, and federal government agencies

OUTLOOK

An increase in business and economic activity worldwide should spur demand for geospatial information scientists and technologists. Opportunities will be best for scientists and technologists with strong technical, computing, and communication skills.

The use of advanced technologies, such as GPS, and GIS, will continue to increase both the accuracy and productivity of these workers. This will limit job growth to some extent. However, job openings will continue to arise from the need to replace workers who leave this occupation.

	Employment		Employment Change	
	2008	2018	Number	Percent
National	209,300	236,800	27,500	13.1
State	1,330	1,340	10	0.8

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later. If you attend a private school, check with your school counselor for graduation requirements. Geospatial information scientists and technologists need a strong background in math and science. Try to take math classes through Trigonometry and science classes through Physics.

You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Computer Applications
- Computer Programming
- Computer Science
- Economics
- Geography
- Keyboarding

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and groups that may be available in your high school or community can be found at http://www.careerkokua.org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Preparation

To work as a geospatial information scientist and technologist, you must:

- have a high school diploma or GED
- complete at least a two-year degree in geospatial information or a related field
- have related work experience;
- have strong math skills
- have a good eye for detail; and
- have good communication skills.

EDUCATION AFTER HIGH SCHOOL

Almost all Geospatial information scientists and technologists have a bachelor's degree in geography, civil engineering, planning, surveying and mapping, or a physical science. In addition, more colleges and universities are offering certificates in geospatial engineering, photogrammetry, or a related field. These programs have a heavy emphasis on using GIS and GPS software. As a student you should also take courses in economics, history, and urban studies.

Technologists can study for this field by gaining an associate degree in geospatial information or a related field and working their way into this occupation through experience. However, the standard education level is a bachelor's degree.

You need a doctoral (Ph.D.) degree to teach geography and geospatial information at a college. Many colleges and universities offer advanced degrees in geography.

WORK EXPERIENCE

Working as a research assistant for a geographer is good experience for this field. Look for this kind of work when you are a college student. Or consider participating in an internship. An internship offers you a chance to apply what you have learned in the classroom to a work situation. It also allows you to build skills and make contacts with people in the field.

ON-THE-JOB TRAINING

Depending on your employer, you may receive training on your first job. The length of training varies by employer, but may last up to one year.

Related Educational Programs

- Computer and Information Sciences
- Construction Trades
- Drafting/Design Technologies
- Engineering
- Engineering Technologies
- Geography
- Geological and Earth Sciences

Hiring Practices

Employers look for technologists who have at least a two-year degree in geospatial information or a related field and work experience. Employers require scientists to have at least a bachelor's degree. For both technologists and scientists, employers look for applicants with strong technical, computing, and communication skills. Work experience or coursework in the particular field of the employer, such as urban planning or agriculture, is often helpful in getting hired.

Advancement Opportunities

Experienced geospatial scientists may advance to jobs that require higher levels of skill and competency. These include jobs in research, administration, and environmental planning. You usually need several years of experience and at least a master's degree to advance.

Technologists usually begin performing more basic tasks and advance through experience. Those with aptitude and leadership ability may move into lead technologist or supervisory roles. They typically must gain at least a bachelor's degree to move into more advanced positions.

Additional Sources of Information

- Hawai'i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai'i Career Information Delivery System, www.careerkokua.org

Geothermal Production Managers

Overview

Geothermal production managers oversee operations at geothermal power plants. They maintain and monitor geothermal equipment for efficient and safe plant operations.

Areas where there is a lot of volcanic activity generate more heat in the earth, and thus are ideal places for geothermal energy. However, geothermal systems can be used anywhere but they may need to be used with traditional heating and cooling sources.

Installing and maintaining geothermal energy systems is a big job. It involves digging deep trenches and wells and installing pipes, pumps, and controls. While technicians perform much of the work, production managers oversee the entire operation. This is true whether it is at a power plant or at a home site.

Geothermal production managers spend a lot of time inspecting installations of new systems. This means they travel to different work sites. They make sure that everything is going according to plan, on time, and on budget. They check with technicians, excavators, and other workers to determine what work has been completed and if there are any problems.

Managers also travel to different sites to check on existing geothermal systems. They check to see that they are functioning properly. They also check that all maintenance and repairs have been done and recorded. They inspect equipment and procedures to locate any inefficiency that may negatively impact how well the system heats and cools. They also look for ways to improve equipment and controls.

Developing budgets, timelines, and schedules is a big part of a manager's job. Once a budget and funding is in place, they must negotiate with landowners, utilities, and local government officials. This is usually in the case of installing a new system. Whenever a new installation or construction is planned, geothermal production managers have to obtain the necessary permits. They must also write and update reports. This is to show that they are complying with rules and regulations.

Geothermal production managers supervise and communicate with technicians and power plant employees. Managers must oversee the work done by others. They offer technical assistance where needed. In some cases, they perform or demonstrate minor repairs themselves.

Managers must also maintain records and files of both big projects and daily operations.

Related Occupations

This occupation is part of the **Manufacturing** cluster of occupations.

Related occupations include:
- Construction and Building Inspectors
- General and Operations Managers
- Geothermal Technicians
- Industrial Production Managers
- Power Plant Operators

Hawai'i Career Pathways:
- Industrial & Engineering Technology

Outlook

Analysts expect that the geothermal energy industry will continue to grow rapidly. This is due to government incentives and increased consumer interest.

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later. If you attend a private school, check with your school counselor for graduation requirements.

You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Computer Applications
- Introduction to Business
- Keyboarding
- Manufacturing Systems

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and groups that may be available in your high school or community can be found at http://www.careerkokua.org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Preparation

To work as a geothermal production manager, you must:

- have a high school diploma or GED;
- have at least a two-year degree;
- have work experience in your area;
- be self-confident and persuasive;
- have strong communication skills; and
- be able to direct and motivate people.

Education after high school

Geothermal production managers usually have an associate or bachelor's degree and related work experience. However, because of the specialized nature of this job, ideal candidates have a bachelor's degree in engineering or business. A bachelor's degree in engineering and a master's degree in business administration (MBA) is good preparation for this occupation.

Work experience

In general, employers prefer to hire people who have several years of experience in the heating and cooling industry. It helps if some of your time is spent as a supervisor.

On-the-job training

Many employers offer training specific to geothermal energy as well as the company's products and policies. The length of training varies by employer.

Related Educational Programs

- Business Management and Administration
- Engineering
- Engineering Technologies

Licensing / Certification / Designation / Registration

Typically, workers who install, test, and maintain electrical systems are required to have an electrician's license.

Additional Sources of Information

- Hawai'i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai'i Career Information Delivery System, www.careerkokua.org

Geothermal Technicians

Overview

Geothermal technicians install and repair geothermal heating and cooling systems. They test, calibrate, and maintain geothermal energy systems.

Areas where there is a lot of volcanic activity generate more heat in the earth, and thus are ideal places for geothermal energy. However, geothermal systems can be used anywhere but they may need to be used in combination with traditional heating and cooling sources.

Geothermal technicians install and maintain geothermal systems at power plants or at specific sites. These systems can be used to heat and cool homes and buildings and to generate electricity. Technicians inspect and test a specific site to determine the amount of heat available. They then decide on the best system that can provide heating and cooling.

Once this is accomplished, technicians and other workers dig trenches and install pipes to channel hot and cool air. They may use or hire others to use heavy equipment such as backhoes and excavators. They also use tools such as compactors and saws. Once pipes are installed, they are connected to pumps and compressors.

Technicians must make sure they everything is installed correctly. They must also make sure that they are linked properly to controls. This is a complex procedure. It involves working with electrical switches, transmitters, gauges, and other equipment. After installation is complete, technicians must test, troubleshoot, and maintain instruments and controls. They also must calibrate and repair them when necessary.

Geothermal technicians also evaluate the flow and temperature of air coming from pumps to see if their initial tests of heating and cooling are correct. They make adjustments where needed. They may recommend and install back-up systems.

Geothermal systems can also be installed in bodies of water. In these projects, technicians must place pipes and pumps where they won't be disturbed by boats and where they do not disturb wildlife.

Related Occupations

This occupation is part of the **Manufacturing** cluster of occupations.

Related occupations include:
- Electronics Engineering Technologists
- Engineering Technicians
- Geothermal Production Managers
- Heating and Cooling System Mechanics

Hawai'i Career Pathways:
- Industrial & Engineering Technology

Outlook

As this occupation grows, programs that focus specifically on geothermal energy as opposed to HVAC will be offered.

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements

for students graduating in 2013 or later. If you attend a private school, check with your school counselor for graduation requirements. You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Blueprint Reading
- Computer Applications
- Computer Science
- Drafting
- Geology
- Keyboarding
- Natural Resources Management
- Probability and Statistics

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and groups that may be available in your high school or community can be found at http://www.careerkokua.org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Preparation

To work as a geothermal technician, you must:

- have a high school diploma or GED;
- complete a formal training program;
- complete on-the-job training; and
- have mechanical aptitude.

Education after high school

Training to work as a geothermal technician is much the same as training to become a heating and cooling system mechanic. Even though geothermal systems are unique, in that they use heat from below the earth's surface, using air to heat and cool a home involves a similar set of skills to those involved in HVAC (heating, ventilation and air conditioning).

As this occupation grows, programs that focus specifically on geothermal energy as opposed to HVAC will be offered. For now, geothermal technicians may complete a formal training program in heating, air conditioning, and refrigeration technology. Professional-technical schools or two-year colleges offer these programs. They grant a certificate or associate degree. In these programs you learn to read schematic drawings, analyze problems, and follow safety procedures. You also learn to determine whether to replace or repair parts.

On-the-job training

After completing a training program, most geothermal technicians learn additional skills on the job from an experienced worker. You begin as a helper and do basic tasks. As you gain experience you work on more difficult tasks. Training includes:

- using equipment and tools;
- making repairs; and
- providing customer service.

Training may last several years.

Related Educational Programs

- Environmental Control Technologies

Licensing / Certification / Designation / Registration

Typically, workers who install, test, and maintain electrical systems are required to have an electrician's license.

Additional Sources of Information

- Hawai'i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai'i Career Information Delivery System, www.careerkokua.org

Manufacturing Engineering Technologists

At a Glance

- Help engineers solve technical problems
- Have at least an associate degree
- Work with engineers and other team members
- Work strictly in the manufacturing setting
- Use computer-aided drafting (CAD) software
- Earn $68,140 per year (Hawai'i median)

Overview

Manufacturing engineering technologists help to develop tools, create designs, and improve equipment for manufacturing processes.

Manufacturing engineering technologists work with engineers to make manufacturing processes run smoothly. People, machines, and computers must work in harmony. Manufacturing engineering technologists must have a firm command of engineering and science, computer software and hardware, and various manufacturing technologies. In many industries they need to know how to program computed-numerically-controlled (CNC) machines. They need a good grasp of industrial design, and the economic costs of their industry.

Manufacturing engineering technologists often work as managers or supervisors. They are the link between line workers and the engineers who create a product. Often they receive designs and ideas and are asked to carry them out. They must be able to take complex ideas and set up machines, tools, and equipment to manufacture them. Manufacturing engineering technologists analyze plans, and prepare images, layouts, and sample blueprints and sketches. To do this, they often use CAD (computer-aided drafting software).

Once production plans are in place, technologists study them to identify ways to make them more efficient and productive. They troubleshoot problems, fix any glitches, and make changes to equipment, tools, or operations. Technologists also plan schedules, order equipment, and ensure workers follow safety rules. They also look for ways to cut costs or energy use.

The green sector of the economy requires new environmentally-friendly products and more efficient manufacturing. Existing manufacturing processes are being retooled to be more energy efficient. As a result, there will likely be increased demand in the green sector of the economy for manufacturing engineering technicians in the future.

Specific Work Activities

The following list of occupational tasks is specific to Manufacturing engineering technologists.

- Recommend changes to assure or improve product quality or reliability.
- Prepare layouts, drawings, or sketches of machinery and equipment, such as shop tooling, scale layouts, and new equipment design.
- Use drafting equipment or computer-aided design software.
- Identify and implement new manufacturing technologies, processes, or equipment.
- Identify opportunities to improve quality, cost, or efficiency of automated equipment.
- Monitor or measure processes to identify ways to reduce losses, decrease time requirements, or improve quality.
- Ensure safety rules and practices are followed.
- Coordinate equipment purchases, installations, or transfers.
- Plan, estimate, or schedule production work.
- Develop or maintain programs associated with automated production equipment.
- Determine how much material to purchase and how to process it as efficiently as possible.

Common Work Activities

Manufacturing engineering technologists perform the following list of tasks, but the tasks are common to many occupations.

- Make decisions and solve problems.
- Get information needed to do the job.
- Communicate with supervisors, peers, or subordinates.
- Use computers.
- Provide information or drawings about devices, equipment, or structures.
- Analyze data or information.
- Process information.
- Think creatively.
- Monitor events, materials, and surroundings.
- Update and use job-related knowledge.
- Organize, plan, and prioritize work.
- Inspect equipment, structures, or materials.
- Establish and maintain relationships.
- Document and record information.
- Evaluate information against standards.
- Identify objects, actions, and events.
- Estimate sizes, quantities, time, cost, or materials needed.
- Develop and build teams.
- Communicate with people from outside the organization.
- Schedule work and activities.

Related Occupations

This occupation is part of the **Science, Technology, Engineering, and Mathematics** cluster of occupations.

Related occupations include:
- Electronics Engineering Technologists
- Engineering Technicians
- Industrial Engineers
- Manufacturing Engineers
- Manufacturing Production Technicians

Hawai'i Career Pathways:
- Industrial & Engineering Technology

Related O*NET Specialties:
- Manufacturing Engineering Technologists

Skills and Abilities

Manufacturing engineering technologists need to:

COMMUNICATE

- Express ideas clearly when speaking or writing.
- Understand spoken and written information.

REASON AND PROBLEM SOLVE

- Combine several pieces of information and draw conclusions.
- Develop rules or follow guidelines when arranging items.
- Notice when something is wrong or is likely to go wrong.
- Use reasoning to discover answers to problems.
- Think of new ideas or original and creative ways to solve problems.
- Concentrate and not be distracted while performing a task.
- Make sense of information that seems without meaning or organization.
- Remember information such as words, numbers, pictures, and procedures.

USE MATH AND SCIENCE

- Choose a mathematical method or formula to solve problems.

PERCEIVE AND VISUALIZE

- Identify a pattern (a figure, object, word, or sound) that is hidden in distracting material.
- Imagine how something will look if it is moved around or its parts are rearranged.
- Quickly and accurately compare letters, numbers, objects, pictures, or patterns.

Working Conditions

In a typical work setting, Manufacturing engineering technologists:

INTERPERSONAL RELATIONSHIPS

- Have a medium level of social interaction with others.
- Communicate with people daily by telephone, e-mail, and in person.
- Write letters and memos on a weekly basis.
- Work as part of a project team.
- Are responsible for the health and safety of other workers.
- Are somewhat responsible for work outcomes and the work done by others.
- Are occasionally placed in conflict situations.

PHYSICAL WORK CONDITIONS

- Often wear protective or safety gear.
- Almost always work indoors. Manufacturing settings may not be temperature-controlled.
- Are regularly exposed to loud sounds and distracting noise levels.
- Are sometimes exposed to contaminants and hazardous equipment.
- Sometimes work within a few feet of other workers.

WORK PERFORMANCE

- Must be very exact and accurate to ensure that production runs go smoothly and efficiently. Errors cost the company time and ultimately money.
- Sometimes consult a supervisor before making a decisions or setting tasks and goals.
- Meet strict weekly deadlines. This makes the work atmosphere somewhat competitive.
- Make decisions that strongly impact coworkers and their company on a weekly basis.
- May repeat the same mental and physical activities.

HOURS / TRAVEL

- Typically work a standard work week. Often work overtime to meet quotas and production deadlines.
- Shift work may be common.

Physical Demands

Manufacturing engineering technologists frequently:

- Sit for long periods of time.
- Use their hands to handle, control, or feel objects, tools, or controls.

It is important for manufacturing engineering technologists to be able to:

- See details of objects whether they are nearby or far away.
- Understand the speech of another person.
- Speak clearly so listeners can understand.
- Determine the distance between objects.
- See differences between colors, shades, and brightness.
- Hold the arm and hand in one position or hold the hand steady while moving the arm.
- Use fingers or hands to grasp, move, or assemble very small objects.

It is not as important, but still necessary, for manufacturing engineering technologists to be able to:

- Make quick, precise adjustments to machine controls.
- Focus on one source of sound and ignore others.
- Hear sounds and recognize the difference between them.
- React quickly using hands, fingers, or feet.
- Move two or more limbs together (for example, two arms, two legs, or one leg and one arm) while remaining in place.
- Make fast, repeated movements of fingers, hands, and wrists.
- Bend, stretch, twist, or reach out.
- Choose quickly and correctly among various movements when responding to different signals.
- Be physically active and use muscles for long periods without getting tired or out of breath.
- Use stomach and lower back muscles to support the body for long periods without getting tired.
- Use muscles to lift, push, pull, or carry heavy objects.
- Adjust body movements or equipment controls to keep pace with speed changes of moving objects.
- Coordinate movement of several parts of the body, such as arms and legs, while the body is moving.
- Keep or regain the body's balance or stay upright when in an unstable position.

Knowledge

Manufacturing engineering technologists need knowledge in the following areas:

- Engineering and Technology: Knowledge of how to build machines, buildings, and other things. Also includes knowledge of how to use computers, machines, and tools to do work more usefully.
- Mechanical: Knowledge of designing, using, and repairing machines and tools.
- Design: Knowledge of making and using plans, blueprints, drawings, and models.
- Mathematics: Knowledge of the rules and uses of numbers. Areas of knowledge include arithmetic, algebra, geometry, and statistics.
- Production and Processing: Knowledge of how products are made and supplied.
- Physics: Knowledge of the features and rules of matter and energy. Areas of knowledge include air, water, light, heat, weather, and other natural events.
- Computers and Electronics: Knowledge of computer hardware and software.
- English Language: Knowledge of the meaning, spelling, and use of the English language.
- Administration and Management: Knowledge of managing the operations of a business, company, or group.
- Education and Training: Knowledge of teaching and the methods involved in learning and instruction.

Interests

Manufacturing engineering technologists are people who tend to:

- Consider achievement important. They like to see the results of their work and to use their strongest abilities. They like to get a feeling of accomplishment from their work.
- Consider independence important. They like to make decisions and try out ideas on their own. They prefer jobs where they can plan their work with little supervision.
- Consider good working conditions important. They like jobs offering steady employment and good pay. They want employment that fits their individual work style. They may prefer doing a variety of tasks, working alone, or being busy all the time.
- Consider recognition important. They like to work in jobs which have opportunities for them to advance, be recognized for their work, and direct and instruct others. They usually prefer jobs in which they are looked up to by others.
- Consider support from their employer important. They like to be treated fairly and have supervisors who will back them up. They prefer jobs where they are trained well.
- Have realistic interests. They like work activities that include practical, hands-on problems and solutions. They like to work with plants, animals, and physical materials such as wood, tools, and machinery. They often prefer to work outside.
- Have investigative interests. They like work activities that have to do with ideas and thinking. They like to search for facts and figure out solutions to problems mentally.
- Have conventional interests. They like work activities that follow set procedures, routines, and standards. They like to work with data and detail. They prefer working where there is a clear line of authority to follow.

Occupational Interest Codes

- RIC

Wages

Pay varies with the worker's level of education, responsibility, and experience. Those who work in manufacturing may belong to a union. When they work overtime or on holidays, they are usually paid more than their usual wage.

Full-time technologists generally receive benefits. Typical benefits are health insurance, a retirement plan, sick leave, and paid vacation. Some companies provide money for continuing education classes.

Location	Pay Period	25%	Median	75%
Hawai'i	Hourly	$25.69	$32.76	$40.54
	Yearly	$53,440	$68,140	$84,330
Honolulu	Hourly	$26.64	$33.75	$41.63
	Yearly	$55,410	$70,190	$86,600
United States	Hourly	$20.47	$27.66	$34.87
	Yearly	$42,580	$57,530	$72,520

Outlook

In Hawai'i, outlook information is not available specifically for manufacturing engineering technologists. However, they are part of a larger group of "engineering technicians, except drafters, all other." Slower than average employment growth is expected for workers in this group through 2018.

Nationally, the number of workers is this group is expected to grow as fast as the average through 2018.

The table below provides information about the number of workers in this occupation in various regions. It also provides information about the expected growth rate and future job openings.

EMPLOYMENT

Major employers:

- Aerospace product and parts manufacturers
- Engineering firms
- Federal, state, and local government agencies
- Motor vehicle parts manufacturers
- Navigational and measuring instrument manufacturers
- Semiconductor and parts manufacturers

OUTLOOK

Competitive pressures will force companies to improve and update manufacturing facilities and product designs. These changes will increase the need for technologists. However, advances in technology are making technologists more productive. Examples of these advances are computer-aided design and computer simulation. These advances may reduce the number of technologists needed to do the same amount of work.

Because the growing green sector of the economy demands both new environmentally friendly products and more efficient manufacturing in general, this job has a bright future.

Employment of manufacturing engineering technologists is related to the economy. During slow periods, technologists will find fewer job openings. International competition will also limit the growth of this occupation.

	Employment		Employment Change	
	2008	2018	Number	Percent
National	76,600	80,600	4,000	5.2
State	630	640	10	1.6

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later. If you attend a private school, check with your school counselor for graduation requirements. Manufacturing engineering technologists need a strong background in math and science. Try to take math classes through Trigonometry and science classes through Physics.

You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses,

you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Blueprint Reading
- Computer Applications
- Computer-Assisted Design (CAD)
- Computer Science
- Drafting
- Manufacturing Systems

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and groups that may be available in your high school or community can be found at http://www.careerkokua.org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Preparation

To work as an manufacturing engineering technologist, you must:

- have a high school diploma or GED;
- complete at least a two-year degree in manufacturing engineering technology or a related field;
- have related work experience; and
- have strong technical and communication skills.

EDUCATION AFTER HIGH SCHOOL

Manufacturing engineering technologists usually need a bachelor's degree in manufacturing engineering technology. More universities are developing engineering programs specifically in this field, but it may still be possible to get a degree in mechanical or industrial engineering and work in this occupation. Engineering programs take four to five years to complete.

Some schools offer associate degree programs in manufacturing engineering technology. Those with a two-year degree may be able to work in this field if they have significant related work experience. However, the trend is for employers to seek applicants with bachelor's degrees.

WORK EXPERIENCE

Consider participating in an internship with an engineering firm while you are in college. An internship offers you a chance to apply what you have learned in the classroom to a work situation. It also allows you to build skills and make contacts with people in the field.

ON-THE-JOB TRAINING

It is common for newly hired manufacturing engineering technologists to receive some on-the-job training. This varies by employer, and can last anywhere from a month to a year.

Related Educational Programs

- Electrical/Electronics Technologies
- Engineering
- Engineering Technologies

Hiring Practices

Employers look for manufacturing engineering technologists who have at least a two-year degree in manufacturing engineering technology or a related field. Employers rarely require applicants to be certified. However, those who are certified may have a competitive edge over other applicants.

Employers look for applicants with strong technical and mechanical skills. Good communication skills are very important because technologists work with engineers and other team members. An interest in math and science is also important.

Advancement Opportunities

Manufacturing engineering technologists usually begin by doing routine or entry-level duties. They work under the close supervision of experienced technologists or engineers. As they gain experience, technologists are given more difficult assignments and have less supervision. Manufacturing engineering technologists with leadership skills may advance to supervisor positions or management. Keeping their skills current through continuing education classes helps technologists to advance.

Additional Sources of Information

- Hawai‘i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai‘i Career Information Delivery System, www.careerkokua.org

Manufacturing Engineers

At a Glance

- Have at least a bachelor's degree
- Work strictly in a manufacturing setting
- Design new manufacturing processes or improve existing ones
- Often work with other technologists and engineers
- Sit for long periods of time
- Earn $82,920 per year (Hawai'i median)

Overview

Manufacturing engineers design and improve manufacturing systems or related processes to increase production and decrease costs.

Manufacturing engineers use their knowledge of math and science to analyze a manufacturing process or production run. They help determine the best series of steps so products are made well and on time. They also make sure that the production uses the least amount of energy and raw materials. For this reason, manufacturing engineers have a strong future in the growing green sector of the economy.

Manufacturing engineers must be logical and detail-oriented. They study production methods to determine where problems might exist. They analyze data to recommend changes or improvements. They look at existing production processes or design new ones. They troubleshoot new designs and periodically review systems to identify problems. By keeping their skills up-to-date, they can apply new ideas about manufacturing. Knowledge of fabrication, tooling, production, assembly, logistics, and quality control are very important in this job. Having a good sense of materials, parts, and design is crucial, too.

Manufacturing engineers work with others, such as supply chain managers and validation engineers. They also discuss ideas with supervisors, directors, and other engineers involved in production.

Specific Work Activities

The following list of occupational tasks is specific to manufacturing engineers.

- Identify ways to improve products or reduce costs.
- Determine causes of failures using statistics. Recommend changes in designs, settings, or processing methods.
- Provide technical expertise or support related to manufacturing.
- Incorporate new methods and processes to improve existing operations.
- Supervise technicians, technologists, analysts, administrative staff, or other engineers.
- Troubleshoot new and existing product problems involving designs, materials, or processes.
- Review product designs for manufacturability and completeness.
- Train production personnel in new or existing methods.
- Communicate manufacturing capabilities, production schedules, or other information to facilitate production processes.

Common Work Activities

Manufacturing engineers perform the following list of tasks, but the tasks are common to many occupations.

- Use computers.
- Make decisions and solve problems.
- Get information needed to do the job.
- Analyze data or information.
- Organize, plan, and prioritize work.
- Monitor events, materials, and surroundings.
- Think creatively.

- Communicate with supervisors, peers, or subordinates.
- Update and use job-related knowledge.
- Provide information or drawings about devices, equipment, or structures.
- Identify objects, actions, and events.
- Estimate sizes, quantities, time, cost, or materials needed.
- Establish and maintain relationships.
- Judge the value of objects, services, or people.
- Schedule work and activities.
- Process information.
- Document and record information.
- Inspect equipment, structures, or materials.
- Develop and build teams.
- Develop goals and strategies.

Related Occupations

This occupation is part of the **Science, Technology, Engineering, and Mathematics** cluster of occupations.

Related occupations include:
- Energy Engineers
- Engineering Managers
- Industrial Engineers
- Manufacturing Engineering Technologists
- Mechanical Engineers
- Robotics Engineers
- Validation Engineers

Hawai'i Career Pathways:
- Industrial & Engineering Technology

Related O*NET Specialties:
- Manufacturing Engineers

Skills and Abilities

Manufacturing engineers need to:

COMMUNICATE

- Express ideas clearly when speaking or writing.
- Understand spoken and written information.

REASON AND PROBLEM SOLVE

- Notice when something is wrong or is likely to go wrong.
- Use reasoning to discover answers to problems.
- Combine several pieces of information and draw conclusions.
- Develop rules or follow guidelines when arranging items.
- Think of new ideas or original and creative ways to solve problems.
- Concentrate and not be distracted while performing a task.
- Make sense of information that seems without meaning or organization.

USE MATH AND SCIENCE

- Choose a mathematical method or formula to solve problems.

PERCEIVE AND VISUALIZE

- Imagine how something will look if it is moved around or its parts are rearranged.
- Identify a pattern (a figure, object, word, or sound) that is hidden in distracting material.
- Quickly and accurately compare letters, numbers, objects, pictures, or patterns.

Working Conditions

In a typical work setting, manufacturing engineers:

INTERPERSONAL RELATIONSHIPS

- Have a high level of social interaction. They work with other engineers, technicians, and managers throughout the day.
- Communicate with people daily by telephone, e-mail, and in person.
- Are greatly responsible for the health and safety of workers.
- Write letters and memos on a weekly basis.
- Are responsible for the outcomes of work and for the work performed by others.
- Occasionally are placed in conflict situations in which others may be rude or angry.

- Work as part of a project team.

PHYSICAL WORK CONDITIONS

- Nearly every day wear safety attire or protective gear.
- Usually work indoors which may not be temperature-controlled. Occasionally work in outdoor spaces.
- Are sometimes exposed to loud sounds and distracting noise levels.
- Are occasionally exposed to contaminants.
- Are occasionally exposed to hazardous equipment and conditions.
- Sometimes work within a few feet of other workers.

WORK PERFORMANCE

- Must be very exact and accurate in their work. Errors can delay production, which costs the employer money.
- Rarely consult a superior before making a decisions or setting tasks and goals.
- Meet strict weekly deadlines. This makes the work atmosphere somewhat competitive.
- Daily make decisions that strongly impact coworkers and their company.
- Repeat the same mental and physical tasks.

HOURS / TRAVEL

- Usually work a standard work week, but overtime is common.

Physical Demands

Manufacturing engineers frequently:

- Sit for long periods of time.

It is important for Manufacturing engineers to be able to:

- See details of objects whether they are nearby or far away.
- Understand the speech of another person.
- Speak clearly so listeners can understand.
- Focus on one source of sound and ignore others.
- See differences between colors, shades, and brightness.
- Hold the arm and hand in one position or hold the hand steady while moving the arm.
- Use fingers to grasp, move, or assemble very small objects.

It is not as important, but still necessary, for manufacturing engineers to be able to:

- Determine the distance between objects.
- Hear sounds and recognize the difference between them.
- Use one or two hands to grasp, move, or assemble objects.
- Make quick, precise adjustments to machine controls.
- Move two or more limbs together (for example, two arms, two legs, or one leg and one arm) while remaining in place.
- React quickly using hands, fingers, or feet.
- Choose quickly and correctly among various movements when responding to different signals.
- Make fast, repeated movements of fingers, hands, and wrists.
- Adjust body movements or equipment controls to keep pace with speed changes of moving objects.
- Use muscles to lift, push, pull, or carry heavy objects.
- Use stomach and lower back muscles to support the body for long periods without getting tired.
- Coordinate movement of several parts of the body, such as arms and legs, while the body is moving.
- Use muscles for extended periods without getting tired.

Knowledge

Manufacturing engineers need knowledge in the following areas:

- Engineering and Technology: Knowledge of how to build machines, buildings, and other things. Also includes knowledge of how to use computers, machines, and tools to do work more usefully.
- Production and Processing: Knowledge of how products are made and supplied.
- Design: Knowledge of making and using plans, blueprints, drawings, and models.

- Mechanical: Knowledge of designing, using, and repairing machines and tools.
- Mathematics: Knowledge of the rules and uses of numbers. Areas of knowledge include arithmetic, algebra, geometry, and statistics.
- Computers and Electronics: Knowledge of computer hardware and software.
- Physics: Knowledge of the features and rules of matter and energy. Areas of knowledge include air, water, light, heat, weather, and other natural events.
- English Language: Knowledge of the meaning, spelling, and use of the English language.
- Administration and Management: Knowledge of managing the operations of a business, company, or group.
- Economics and Accounting: Knowledge of producing, supplying, and using goods and services. Also includes knowledge of the methods for keeping business records.
- Education and Training: Knowledge of teaching and the methods involved in learning and instruction.
- Chemistry: Knowledge of the properties of substances and the changes that occur when they interact.

Interests

Manufacturing engineers are people who tend to:

- Consider good working conditions important. They like jobs offering steady employment and good pay. They want employment that fits their individual work style. They may prefer doing a variety of tasks, working alone, or being busy all the time.
- Consider support from their employer important. They like to be treated fairly and have supervisors who will back them up. They prefer jobs where they are trained well.
- Consider recognition important. They like to work in jobs which have opportunities for them to advance, be recognized for their work, and direct and instruct others. They usually prefer jobs in which they are looked up to by others.
- Consider independence important. They like to make decisions and try out ideas on their own. They prefer jobs where they can plan their work with little supervision.
- Consider achievement important. They like to see the results of their work and to use their strongest abilities. They like to get a feeling of accomplishment from their work.
- Have realistic interests. They like work activities that include practical, hands-on problems and solutions. They like to work with plants, animals, and physical materials such as wood, tools, and machinery. They often prefer to work outside.
- Have investigative interests. They like work activities that have to do with ideas and thinking. They like to search for facts and figure out solutions to problems mentally.

Occupational Interest Codes

- RI

Wages

Wages vary by employer and area of the country. The engineer's level of training, experience, and responsibility also affect wages.

Manufacturing engineers who work full time usually receive benefits. Typical benefits include sick leave, paid vacation, and health insurance. Some employers also provide a retirement plan.

Location	Pay Period	25%	Median	75%
Hawai'i	Hourly	$30.51	$39.86	$45.89
	Yearly	$63,460	$82,920	$95,450
Honolulu	Hourly	$33.58	$40.55	$46.16
	Yearly	$69,850	$84,350	$96,010
United States	Hourly	$32.22	$43.06	$54.33
	Yearly	$67,030	$89,560	$113,010

Outlook

In Hawai'i and nationally, outlook information is not specifically available for manufacturing engineers. However, they are included in a larger group of "engineers, all other." Little change in employment is expected for workers in this group through 2018.

The table below provides information about the number of workers in this occupation in various regions. It also provides information about the expected growth rate and future job openings.

EMPLOYMENT

Major employers:

- Aerospace product and parts manufacturers
- Engineering firms
- Federal, state, and local government agencies
- Motor vehicle parts manufacturers
- Navigational and measuring instrument manufacturers
- Semiconductor and parts manufacturers

OUTLOOK

Because the growing green sector of the economy demands both new environmentally friendly products and more efficient manufacturing in general, this job has a bright future. Also, competitive pressures will force companies to improve and update manufacturing facilities and product designs. These changes will increase the need for manufacturing engineers.

International competition will limit the growth of this occupation. However, job openings will continue to arise from the need to replace workers who transfer to other occupations or leave the labor force.

	Employment		Employment Change	
	2008	2018	Number	Percent
National	183,200	195,400	12,200	6.7
State	730	730	0	0.0

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later. If you attend a private school, check with your school counselor for graduation requirements. Manufacturing engineers use math and science frequently. Try to take math classes through Trigonometry and science classes through Physics.

You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Blueprint Reading
- Computer Applications
- Computer-Assisted Design (CAD)
- Computer Science
- Drafting
- Manufacturing Systems

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and groups that may be available in your high school or community can be found at http://www.careerkokua.

org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Preparation

To work as a manufacturing engineer, you must:

- have a high school diploma or GED;
- complete a bachelor's degree in manufacturing engineering or a closely related field;
- be curious and detail-oriented;
- have strong analytical skills; and
- be creative.

Education After High School

Most students prepare for this field by earning a bachelor's degree in manufacturing engineering. Many four-year colleges and universities offer this program of study. You may need between four and five years to complete this program. You may also be able to work in this field by completing a degree in industrial engineering or a related specialty.

Some two-year colleges have agreements with the engineering departments at four-year schools. These agreements allow you to take your first two years of courses at the two-year college. Then you move to the university for the last two years. Some liberal arts schools have similar programs to prepare you for engineering schools.

Some jobs require a master's or doctoral degree (Ph.D.). For instance, if you are interested in teaching manufacturing engineering you need a Ph.D. Also, many engineers go to graduate school to specialize in an area of manufacturing engineering.

Work Experience

Consider participating in an internship with a manufacturing firm while in college. An internship offers you a chance to apply what you have learned in the classroom to a work situation. It also allows you to build skills and make contacts with people in the field.

On-the-Job Training

In general, manufacturing engineers receive on-the-job training. The length of training varies by employer. Recent graduates work under the guidance of experienced engineers. In large companies, you may also receive formal classroom training. As you gain knowledge and experience you have greater independence and work on more difficult tasks.

Related Educational Programs

- Engineering
- Engineering Technologies

Hiring Practices

Most employers require that manufacturing engineers have at least a bachelor's degree in engineering. Many employers require a master's degree and experience in the manufacturing world. Employers also look for people with strong communication, computer, and technical skills. Certification or licensing may also be required.

Licensing / Certification / Designation / Registration

In Hawai'i, engineers (except those employed by the federal government) whose work involves the safety or health of the public must be licensed by the Hawai'i board of professional engineers, architects, surveyors, and landscape architects. In Hawai'i, licenses are offered in seven disciplines of engineering which include agriculture, chemical, civil, electrical, industrial, mechanical, and structural. Licensure requires meeting educational and experience requirements, passing an exam, and paying fees.

Advancement Opportunities

Manufacturing engineers advance by becoming licensed. After graduation, engineers usually take an exam on the fundamentals of engineering. Next, manufacturing engineers work under the supervision

of a licensed professional engineer for a period of years that is determined by the state board of examiners. Once they have met the work experience requirements, they can take another exam to become a professional engineer.

Once manufacturing engineers pass the professional exam and get licensed, they have many options for advancement. They may be given more complex projects and be assigned as the lead engineer. They may move into management positions. Professional manufacturing engineers can also start their own consulting firms.

Additional Sources of Information

- Hawai‘i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai‘i Career Information Delivery System, www.careerkokua.org

Manufacturing Production Technicians

At a Glance

- Work with their hands to install, test, and fix manufacturing equipment
- Work with technologists and engineers
- Stand for long periods of time
- Have a one-year certificate or a two-year degree
- Ensure quality and safety
- Earn $68,140 per year (Hawai'i median)

Overview

Manufacturing production technicians set up, test, and adjust manufacturing machinery and equipment.

Manufacturing production technicians work with engineers and technologists to make sure that everything about production works efficiently. Technicians are close to the production process along with the line workers.

Overseeing the production process is the main task of manufacturing production technicians. They also make sure that production quotas are met. If they spot any problems, they make adjustments to tools, equipment, and machines. Periodically they must calibrate and reset the same tools, equipment, and machines to keep them running and working well. To perform these tasks, they use hand tools such as calipers, micrometers, height gauges, protractors, and ring gauges. They inspect finished products to determine if they meet quality standards.

Technicians set up new equipment or rearrange equipment for a new product or process. They test equipment to make sure it works well. They often plan production schedules. In addition, they start up and shut down machines at the end of a work shift or production run.

The green sector of the economy requires new environmentally-friendly products and more efficient manufacturing. Existing manufacturing processes are being retooled to be more energy efficient. As a result, there will likely be increased demand in the green sector of the economy for manufacturing production technicians in the future.

Specific Work Activities

The following list of occupational tasks is specific to manufacturing production technicians.

- Follow all regulations, policies, and procedures for health, safety, and environmental compliance.
- Inspect finished products for quality and if they match customer specifications.
- Set up and operate production equipment.
- Calibrate and adjust equipment to ensure quality, using tools such as calipers, micrometers, height gauges, protractors, and ring gauges.
- Set up safety equipment, making sure it works properly.
- Monitor and adjust production processes or equipment for quality and productivity.
- Troubleshoot problems with equipment, devices, or products.
- Test products or subassemblies for functionality or quality.
- Plan and lay out work to meet production and schedule requirements.
- Start up and shut down processing equipment.

Common Work Activities

Manufacturing production technicians perform the following list of tasks, but the tasks are common to many occupations.

- Make decisions and solve problems.
- Control machines and processes.

- Get information needed to do the job.
- Communicate with supervisors, peers, or subordinates.
- Monitor events, materials, and surroundings.
- Inspect equipment, structures, or materials.
- Evaluate information against standards.
- Update and use job-related knowledge.
- Think creatively.
- Identify objects, actions, and events.
- Use computers.
- Repair and maintain mechanical equipment.
- Provide information or drawings about devices, equipment, or structures.
- Estimate sizes, quantities, time, cost, or materials needed.
- Analyze data or information.
- Organize, plan, and prioritize work.
- Process information.
- Document and record information.
- Handle and move objects.
- Establish and maintain relationships.

Related Occupations

This occupation is part of the **Manufacturing** cluster of occupations.

Related occupations include:
- Industrial Machinery Mechanics
- Manufacturing Engineering Technologists
- Numerical Control Machine Operators
- Production Helpers
- Quality Control Inspectors

Hawai'i Career Pathways:
- Industrial & Engineering Technology

Related O*NET Specialties:
- Manufacturing Production Technicians

Skills and Abilities

Manufacturing production technicians need to:

COMMUNICATE

- Express ideas clearly when speaking or writing.
- Understand spoken and written information.

REASON AND PROBLEM SOLVE

- Notice when something is wrong or is likely to go wrong.
- Combine several pieces of information and draw conclusions.
- Use reasoning to discover answers to problems.
- Concentrate and not be distracted while performing a task.
- Develop rules or follow guidelines when arranging items.

USE MATH AND SCIENCE

- Add, subtract, multiply, and divide quickly and correctly.

PERCEIVE AND VISUALIZE

- Imagine how something will look if it is moved around or its parts are rearranged.
- Identify a pattern (a figure, object, word, or sound) that is hidden in distracting material.
- Quickly and accurately compare letters, numbers, objects, pictures, or patterns.

Working Conditions

In a typical work setting, manufacturing production technicians:

INTERPERSONAL RELATIONSHIPS

- Have a low to medium level of social interaction.
- Are somewhat responsible for the health and safety of others workers.
- Communicate mostly by talking to others in person. They also write email and use the telephone on a regular basis.
- Often work as part of a project team.
- Occasionally write letters and memos.
- Are somewhat responsible for the work done by others.
- Occasionally are placed in conflict situations.

PHYSICAL WORK CONDITIONS

- Wear safety attire or protective gear on a daily basis.
- Usually work indoors. These sites may not be temperature-controlled.
- Are often exposed to loud sounds and distracting noise levels.
- Are exposed to hazardous equipment on a weekly basis.
- Are sometimes exposed to contaminants.

WORK PERFORMANCE

- Must be very exact and accurate when performing the job. Slowing down the production line costs money.
- Usually consult a supervisor before making a decision or setting daily tasks and goals. Their decisions impact their employer's reputation and the work done by other employees.
- Must meet strict weekly deadlines. This may make the work environment somewhat competitive.
- Must match the pace of work to the speed of equipment.
- Repeat the same physical and mental tasks.

HOURS / TRAVEL

- Usually work a standard 40-hour work week, but overtime may be necessary to meet deadlines or quotas.
- Shift work may be common.

Physical Demands

Manufacturing production technicians frequently:

- Stand for long periods of time.
- Use their hands to handle, control, or feel objects, tools, or controls.

It is important for manufacturing production technicians to be able to:

- See details of objects that are less than a few feet away.
- Speak clearly so listeners can understand.
- Hold the arm and hand in one position or hold the hand steady while moving the arm.
- Make quick, precise adjustments to machine controls.
- Use fingers or hands to grasp, move, or assemble very small objects.
- Understand the speech of another person.
- React quickly using hands, fingers, or feet.
- Focus on one source of sound and ignore others.

It is not as important, but still necessary, for manufacturing production technicians to be able to:

- Hear sounds and recognize the difference between them.
- See details of objects that are more than a few feet away.
- Use stomach and lower back muscles to support the body for long periods without getting tired.
- See differences between colors, shades, and brightness.
- Determine the distance between objects.
- Move two or more limbs together (for example, two arms, two legs, or one leg and one arm) while remaining in place.
- Adjust body movements or equipment controls to keep pace with speed changes of moving objects.
- Bend, stretch, twist, or reach out.
- Be physically active and use muscles for long periods without getting tired or out of breath.
- Use muscles to lift, push, pull, or carry heavy objects.
- Choose quickly and correctly among various movements when responding to different signals.
- Coordinate movement of several parts of the body, such as arms and legs, while the body is moving.
- Keep or regain the body's balance or stay upright when in an unstable position.

Knowledge

Manufacturing production technicians need knowledge in the following areas:

- Mechanical: Knowledge of designing, using, and repairing machines and tools.
- Production and Processing: Knowledge of how products are made and supplied.

- Engineering and Technology: Knowledge of how to build machines, buildings, and other things. Also includes knowledge of how to use computers, machines, and tools to do work more usefully.
- Mathematics: Knowledge of the rules and uses of numbers. Areas of knowledge include arithmetic, algebra, geometry, and statistics.
- Design: Knowledge of making and using plans, blueprints, drawings, and models.
- Computers and Electronics: Knowledge of computer hardware and software.
- English Language: Knowledge of the meaning, spelling, and use of the English language.

Interests

Manufacturing production technicians are people who tend to:

- Consider support from their employer important. They like to be treated fairly and have supervisors who will back them up. They prefer jobs where they are trained well.
- Consider independence important. They like to make decisions and try out ideas on their own. They prefer jobs where they can plan their work with little supervision.
- Consider achievement important. They like to see the results of their work and to use their strongest abilities. They like to get a feeling of accomplishment from their work.
- Consider good working conditions important. They like jobs offering steady employment and good pay. They want employment that fits their individual work style. They may prefer doing a variety of tasks, working alone, or being busy all the time.
- Have realistic interests. They like work activities that include practical, hands-on problems and solutions. They like to work with plants, animals, and physical materials such as wood, tools, and machinery. They often prefer to work outside.
- Have investigative interests. They like work activities that have to do with ideas and thinking. They like to search for facts and figure out solutions to problems mentally.

Occupational Interest Codes

- RI

Wages

Pay varies with the worker's level of education, responsibility, and experience. Those who work in manufacturing may belong to a union. When they work overtime or on holidays, they are usually paid more than their usual wage.

Full-time technicians generally receive benefits. Typical benefits are health insurance, a retirement plan, sick leave, and paid vacation. Some companies provide money for continuing education classes.

Location	Pay Period	25%	Median	75%
Hawai'i	Hourly	$25.69	$32.76	$40.54
	Yearly	$53,440	$68,140	$84,330
Honolulu	Hourly	$26.64	$33.75	$41.63
	Yearly	$55,410	$70,190	$86,600
United States	Hourly	$20.47	$27.66	$34.87
	Yearly	$42,580	$57,530	$72,520

Outlook

In Hawai'i and nationally, outlook information is not available specifically for manufacturing production technicians. However, they are part of a larger group of "engineering technicians, except drafters, all other." Slower than average employment growth is expected for workers in this group through 2018.

The table below provides information about the number of workers in this occupation in various regions. It also provides information about the expected growth rate and future job openings.

Employment

Major employers:

- Aerospace product and parts manufacturers

- Federal, state, and local government agencies
- Motor vehicle parts manufacturers
- Navigational and measuring instrument manufacturers
- Semiconductor and parts manufacturers

OUTLOOK

Competitive pressures will force companies to improve and update manufacturing facilities and product designs. These changes will increase the need for technicians. However, advances in technology are making technicians more productive. Examples of these advances are computer-aided design and computer simulation. These advances may reduce the number of technicians needed to do the same amount of work.

Because the growing green sector of the economy demands both new environmentally friendly products and more efficient manufacturing in general, this job has a bright future.

Employment of manufacturing production technicians is related to the economy. During slow periods, technicians will find fewer job openings. International competition will also limit the growth of this occupation.

	Employment		Employment Change	
	2008	2018	Number	Percent
National	76,600	80,600	4,000	5.2
State	630	640	10	1.6

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later. If you attend a private school, check with your school counselor for graduation requirements.

You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Algebra
- Computer Fundamentals
- Electronics
- Equipment Maintenance and Repair
- Industrial Safety and First Aid
- Manufacturing Systems

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and groups that may be available in your high school or community can be found at http://www.careerkokua.org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Preparation

To work as a manufacturing production technician, you must:

- have a high school diploma or GED;
- complete a certificate in manufacturing production technology or a related field;
- have practical, hands-on skills;
- have good math skills; and
- be creative.

EDUCATION AFTER HIGH SCHOOL

Most people prepare for this occupation by getting a one-year certificate in manufacturing production after high school. Many community colleges and vocational schools offer one-year programs in this field. Some also offer associate's degrees in this or a related field, such as industrial engineering technology.

It is important to verify the kind and quality of manufacturing production programs. Carefully select your program. Make sure the school has the type of training you want, up-to-date equipment, and qualified instructors. Check with employers to see which schools they prefer. Ask the schools for the names of employers where they have placed graduates.

Training programs approved by the Accreditation Board for Engineering and Technology (ABET) meet standards set by the industry. Graduating from an ABET accredited program can give you an advantage with employers.

Pre-engineering programs are not the same as technician programs. Pre-engineering programs stress classroom theory. In contrast, manufacturing production programs stress hands-on training.

WORK EXPERIENCE

Working in jobs that give you practical experience is good background for this occupation. For instance, repairing, installing, or assembling devices and equipment is good experience for manufacturing production technician jobs.

ON-THE-JOB TRAINING

As a new technician, you perform routine tasks while closely supervised by an experienced technician or engineer. As you gain experience, you work on tasks that are more difficult. Training may last a month up to a year.

Related Educational Programs

- Electrical/Electronics Technologies
- Engineering
- Engineering Technologies

Hiring Practices

Employers look for manufacturing production technicians who have a certificate in manufacturing production. Employers also seek applicants with strong technical and mechanical skills. Good communication skills are very important because technicians work with engineers and other team members. An interest in math and science is also important. Previous experience in a manufacturing setting is attractive to employers.

Advancement Opportunities

Manufacturing production technicians usually begin by doing routine duties. They work under the close supervision of experienced technicians, technologists, or engineers. As they gain experience, technicians are given more difficult assignments and have less supervision. Manufacturing production technicians with leadership skills may advance to supervisor positions. Keeping their skills current through continuing education classes helps technicians to advance.

With additional education, technicians can become engineers.

Additional Sources of Information

- Hawai'i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai'i Career Information Delivery System, www.careerkokua.org

Photonics Engineers

At a Glance

- Work with lasers and fiber optics
- Have at least a bachelor's degree
- Often work in the telecommunications industry
- Are very good at math, physics, and science
- Sit for long periods of time
- Earn $82,920 per year (Hawai'i median)

Overview

Photonics engineers use their knowledge of engineering and mathematics to design laser and fiber optic technology.

Lasers and fiber optics have applications in a variety of fields. In medicine, lasers are used for delicate surgical procedures. In manufacturing, powerful lasers are used for marking, cutting, and shaping materials. In the military, lasers are used to aim weapons with pinpoint accuracy. Fiber optics are used in telecommunications, including computer networks like the Internet. If you are reading this on a computer, chances are good that the data spent some time on a fiber optic path on its way to your screen.

The tasks of a photonics engineer vary based on the specific field and application. Most engineers develop new products and systems that use optics and photonics. This may mean that a photonics engineer in a manufacturing setting may create a new laser device to cut plastic. Or, an engineer may work on refining optical cables to reduce energy loss. They often develop prototypes first to see if their ideas can be developed further.

Engineers in this field spend a lot of time analyzing system performance to see if it's working efficiently. They also conduct tests to see if a system or product functions well. They often recommend changes through reports and proposals. Because this is a growing field, photonics engineers also spend a lot of time keeping up-to-date with new developments in optics and laser technology.

Specific Work Activities

The following list of occupational tasks is specific to photonics engineers:

- Design, integrate, or test photonics systems and components.
- Develop optical or imaging systems such as optical imaging products, optical components, image processes, signal process technologies, and optical systems.
- Analyze system performance or operational requirements.
- Write reports or research proposals.
- Assist in the transition of photonic prototypes to production.
- Develop and test photonic prototypes or models.
- Conduct testing to determine functionality and optimization or to establish limits of photonics systems or components.
- Design electro-optical sensing or imaging systems.
- Read current literature, talk with colleagues, continue education, or participate in professional organizations or conferences to keep abreast of developments in the field.
- Conduct research on new photonics technologies.

Common Work Activities

Photonics engineers perform the following list of tasks, but the tasks are common to many occupations.

- Analyze data or information.
- Process information.
- Make decisions and solve problems.
- Get information needed to do the job.

- Use computers.
- Estimates sizes, quantities, time, cost, or materials needed.
- Think creatively.
- Update and use job-related knowledge.
- Communicate with supervisors, peers, or subordinates.
- Identify objects, actions, and events.
- Provide information or drawings about devices, equipment, or structures.
- Document and record information.
- Evaluate information against standards.
- Organize, plan, and prioritize work.
- Explain the meaning of information to others.
- Develop goals and strategies.
- Monitor events, materials, and surroundings.
- Communicate with people from outside the organization.
- Establish and maintain relationships.
- Schedule work and activities.

Related Occupations

This occupation is part of the **Science, Technology, Engineering, and Mathematics** cluster of occupations.

Related occupations include:
- Electrical and Electronics Engineers
- Industrial Engineers

Hawai'i Career Pathways:
- Industrial & Engineering Technology

Related O*NET Specialties:
- Photonics Engineers

Skills and Abilities

Photonics engineers need to:

COMMUNICATE

- Express ideas clearly when speaking or writing.
- Understand spoken and written information.

REASON AND PROBLEM SOLVE

- Use reasoning to discover answers to problems.
- Develop rules or follow guidelines when arranging items in a certain order.
- Notice when something is wrong or is likely to go wrong.
- Combine several pieces of information and draw conclusions.
- Think of new ideas or original and creative ways to solve problems.
- Concentrate and not be distracted while performing a task.

USE MATH AND SCIENCE

- Choose a mathematical method or formula to solve problems.

PERCEIVE AND VISUALIZE

- Imagine how something will look if it is moved around or its parts are rearranged.
- Identify a pattern (a figure, object, word, or sound) that is hidden in distracting material.
- Quickly and accurately compare letters, numbers, objects, pictures, or patterns.

Working Conditions

In a typical work setting, photonics engineers:

INTERPERSONAL RELATIONSHIPS

- Have a medium level of interaction with others.
- Communicate with people daily by telephone, e-mail, and in person.
- Write letters and memos on a weekly basis.
- Work as part of a project team.
- Are somewhat responsible for work outcomes or the work done by others.
- Are somewhat responsiblef for the health and safety of other workers.

PHYSICAL WORK CONDITIONS

- Usually work indoors.
- Sometimes wear protective or safety attire.
- May work within a few feet of others, such as when sharing an office.

WORK PERFORMANCE

- Must make sure that their work is exact and accurate. Errors can cost time and money and delay the completion of a project.
- Rarely consult a supervisor before making a decisions or setting tasks and goals.
- Meet strict weekly and monthly deadlines. This makes the work atmosphere somewhat competitive.
- Monthly make decisions that impact coworkers and their company.

HOURS / TRAVEL

- Usually work a standard work week, but overtime is common when deadlines are near.

Physical Demands

Photonics engineers frequently:

- Sit for long periods of time.
- Use their hands to handle, control, or feel objects, tools, or controls.

It is important for photonics engineers to be able to:

- See details of objects whether they are nearby or far away.
- Speak clearly so listeners can understand.
- Understand the speech of another person.
- See differences between colors, shades, and brightness.

It is not as important, but still necessary, for photonics engineers to be able to:

- Use fingers or hands to grasp, move, or assemble very small objects.
- Hold the arm and hand in one position or hold the hand steady while moving the arm.
- Make quick, precise adjustments to machine controls.
- Determine the distance between objects.
- Hear sounds and recognize the difference between them.
- Move two or more limbs together (for example, two arms, two legs, or one leg and one arm) while remaining in place.
- See objects in very bright or glaring light.
- Focus on one source of sound and ignore others.
- Choose quickly and correctly among various movements when responding to different signals.

Knowledge

Photonics engineers need knowledge in the following areas:

- Engineering and Technology: Knowledge of how to build machines, buildings, and other things. Also includes knowledge of how to use computers, machines, and tools to do work more usefully.
- Physics: Knowledge of the features and rules of matter and energy. Areas of knowledge include air, water, light, heat, weather, and other natural events.
- Design: Knowledge of making and using plans, blueprints, drawings, and models.
- Mathematics: Knowledge of the rules and uses of numbers. Areas of knowledge include arithmetic, algebra, geometry, and statistics.
- Computers and Electronics: Knowledge of computer hardware and software.
- English Language: Knowledge of the meaning, spelling, and use of the English language.
- Production and Processing: Knowledge of how products are made and supplied.
- Mechanical: Knowledge of designing, using, and repairing machines and tools.

Interests

Photonics engineers are people who tend to:

- Consider achievement important. They like to see the results of their work and to use their strongest abilities. They like to get a feeling of accomplishment from their work.
- Consider independence important. They like to make decisions and try out ideas on their own. They prefer jobs where they can plan their work with little supervision.
- Consider good working conditions important. They like jobs offering steady employment and good pay.

They want employment that fits their individual work style. They may prefer doing a variety of tasks, working alone, or being busy all the time.
- Consider recognition important. They like to work in jobs which have opportunities for them to advance, be recognized for their work, and direct and instruct others. They usually prefer jobs in which they are looked up to by others.
- Have investigative interests. They like work activities that have to do with ideas and thinking. They like to search for facts and figure out solutions to problems mentally.
- Have realistic interests. They like work activities that include practical, hands-on problems and solutions. They like to work with plants, animals, and physical materials such as wood, tools, and machinery. They often prefer to work outside.
- Have conventional interests. They like work activities that follow set procedures, routines, and standards. They like to work with data and detail. They prefer working where there is a clear line of authority to follow.

OCCUPATIONAL INTEREST CODES

- IRC

Wages

Wages vary by employer and area of the country. The engineer's level of training, experience, and responsibility also affect wages. Photonics engineers who work full time usually receive benefits. Typical benefits include sick leave, paid vacation, and health insurance. Some employers also provide a retirement plan.

Location	Pay Period	25%	Median	75%
Hawai'i	Hourly	$30.51	$39.86	$45.89
	Yearly	$63,460	$82,920	$95,450
Honolulu	Hourly	$33.58	$40.55	$46.16
	Yearly	$69,850	$84,350	$96,010
United States	Hourly	$32.22	$43.06	$54.33
	Yearly	$67,030	$89,560	$113,010

Outlook

In Hawai'i, outlook information is not available specifically for photonics engineers. However, they are included in a larger group of "engineers, all other." Little change in employment is expected for workers in this group through 2018.

Nationally, employment of workers in this group is expected to grow slower than average through 2018.

The table below provides information about the number of workers in this occupation in various regions. It also provides information about the expected growth rate and future job openings.

EMPLOYMENT

Major employers:
- Engineering firms
- Federal government agencies

OUTLOOK

The outlook for engineers varies by industry. The demand for new products and systems that use optics and photonics is expected to grow. This will create job opportunities for photonics engineers. Opportunities will be best for engineers with strong communication, computer, and technical skills.

	Employment		Employment Change	
	2008	2018	Number	Percent
National	183,200	195,400	12,200	6.7
State	730	730	0	0.0

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/

Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later. If you attend a private school, check with your school counselor for graduation requirements. Photonics engineers use math and science frequently. Try to take math classes through Trigonometry and science classes through Physics.

You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Blueprint Reading
- Computer Applications
- Computer Science
- Electronics

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and groups that may be available in your high school or community can be found at http://www.careerkokua.org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Preparation

To work as a photonics engineer, you must:

- have a high school diploma or GED;
- complete at least a bachelor's degree; and
- have strong technical and communication skills.

Education After High School

Photonics engineers need at least a bachelor's degree in photonics or optical engineering. Some work in this field with a degree in electronic engineering or physics. Engineering programs take four to five years to complete.

It is becoming common for workers in this field to receive a master's degree in photonics engineering. Because this field is complex, some employers favor advanced degrees.

Work Experience

You should consider participating in an internship with an engineering firm while you are in college. An internship offers you a chance to apply what you have learned in the classroom to a work situation. It also allows you to build skills and make contacts with people in the field.

Many laser and fiber optics engineering companies have their own testing labs. Getting a summer job in an "in house" laboratory is a good way to gain experience and make contacts.

On-the-Job Training

It is common for newly hired photonics engineers to receive some on-the-job training. This varies by employer, and can last anywhere from one to six months.

Related Educational Programs

- Electrical/Electronics Technologies
- Engineering
- Physics

Hiring Practices

Most employers require that photonics engineers have at least a bachelor's degree in engineering. Many employers will require a master's degree. Employers also look for people with strong communication, computer, and technical skills. Certification or licensing may also be required.

Licensing / Certification / Designation / Registration

In Hawai'i, engineers (except those employed by the federal government) whose work involves the safety or health of the public must be licensed by the Hawai'i board of professional engineers, architects, surveyors, and landscape architects. In Hawai'i, licenses are offered in seven disciplines of engineering which include agriculture, chemical, civil, electrical, industrial, mechanical, and structural. Licensure requires meeting educational and experience requirements, passing an exam, and paying fees.

Advancement Opportunities

Photonics engineers advance by becoming licensed. After graduation, engineers usually take an exam on the fundamentals of engineering. Next, photonics engineers work under the supervision of a licensed professional engineer for a period of years that is determined by the state board of examiners. Once they have met the work experience requirements, they can take another exam to become a professional engineer.

Once photonics engineers pass the professional exam and get licensed, they have many options for advancement. They may be given more complex projects and be assigned as the lead engineer. They may move into management positions. Professional photonics engineers can also start their own consulting firms.

Additional Sources of Information

- Hawai'i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai'i Career Information Delivery System, www.careerkokua.org

Precision Agriculture Technicians

At a Glance

- Use computers and Geographic Information Systems (GIS)
- Help to improve agricultural practices so they are extremely efficient
- Train through one- and two-year programs
- Sit for long periods of time
- Are good at math and science
- Earn $49,350 per year (Hawai‘i median)

Overview

Precision agriculture technicians use Geographic Information Systems (GIS) and Global Positioning System (GPS) to improve agricultural practices. They use data to make precise decisions about watering, planting, and pesticide application.

Precision agriculture technicians make farming more efficient. They use technology such as GPS and GIS to make decisions about how to manage crops. This way, farmers and agricultural engineers can control many variables to make sure that crops grow well and high yields are delivered.

Technicians rely heavily on data and mapping from GPS and GIS systems. These kinds of maps typically don't tell direction, but give information. Examples include where pests are or what areas need water. These kinds of maps can also give information about soil type, helping farmers decide on the best kinds of fertilizers to use and what kinds of crops to plant.

Using precision technologies gives technicians many advantages. It prevents planting corn in soil that would be better suited for cotton, for example. Technicians can avoid spraying pesticides and herbicides in areas where they are not needed. This way, dangerous run-off of these chemicals can be avoided. It can also save farmers money, because they are only using resources where and when they are needed. For these reasons, precision agriculture technicians have a growing future in the green economy. Combined with other environmentally friendly technologies and practices, precision agriculture can lessen the impact on our land.

Precision agriculture technicians must be knowledgeable about agriculture and GIS and GPS systems. They must have a solid background in agronomy, including soil and crop science. They must also be highly skilled in using sophisticated computer software. They need to know how to gather and analyze data so they can make informed decisions. They must be organized and detail-oriented. They must also be constantly aware of changing regulations related to agriculture.

Specific Work Activities

The following list of occupational tasks is specific to precision agriculture technicians.

- Collect information about soil and fields, crop yields, or field boundaries. Use field data recorders and basic geographic information systems (GIS).
- Create and analyze maps showing agricultural data such as crop yields, soil type, terrain, drainage patterns, and field management history.
- Document and maintain records of precision agriculture information.
- Compile and analyze data to determine soil quality, terrain, field productivity, fertilizers, and weather conditions.
- Divide agricultural fields into zones based on soil characteristics and production potentials.
- Identify soil sampling sites, using geospatial technology. Use this to test soils for nitrogen, phosphorus, and potassium content, pH, and micronutrients.
- Compare crop yield maps with maps of soil test data, chemical application patterns, or other information to develop crop management plans.

- Apply knowledge of government regulations when making agricultural recommendations.
- Draw and read maps such as soil, contour, and plat maps.
- Recommend best crop varieties for specific field areas, based on analysis of geospatial data.

Common Work Activities

Precision agriculture technicians perform the following list of tasks, but the tasks are common to many occupations.

- Use computers.
- Get information needed to do the job.
- Document and record information.
- Analyze data or information.
- Process information.
- Make decisions and solve problems.
- Explain the meaning of information to others.
- Update and use job-related knowledge.
- Provide advice and consultation to others.
- Identify objects, actions, and events.
- Monitor events, materials, and surroundings.
- Communicate with people from outside the organization.
- Establish and maintain relationships.
- Organize, plan, and prioritize work.
- Communicate with supervisors, peers, or subordinates.
- Think creatively.
- Operate vehicles or mechanized equipment.
- Teach others.
- Perform activities that use the whole body.
- Schedule work and activities.

Related Occupations

This occupation is part of the **Agriculture, Food, and Natural Resources** cluster of occupations.

Related occupations include:
- Conservation Scientists
- Engineering Technicians
- Geographic Information Systems Specialists
- Geospatial Information Scientists and Technologists
- Surveying and Mapping Technicians

Hawai'i Career Pathways:
- Natural Resources

Related O*NET Specialties:
- Precision Agriculture Technicians

Skills and Abilities

Precision agriculture technicians need to:

COMMUNICATE

- Express ideas clearly when speaking or writing.
- Understand spoken and written information.

REASON AND PROBLEM SOLVE

- Combine several pieces of information and draw conclusions.
- Use reasoning to discover answers to problems.
- Develop rules or follow guidelines when arranging items in a certain order.
- Notice when something is wrong or is likely to go wrong.
- Concentrate and not be distracted while performing a task.

USE MATH AND SCIENCE

- Choose a mathematical method or formula to solve problems.

MANAGE ONESELF, PEOPLE, TIME, AND THINGS

- Go back and forth between two or more activities or sources of information without becoming confused.

PERCEIVE AND VISUALIZE

- Identify a pattern (a figure, object, word, or sound) that is hidden in distracting material.
- Imagine how something will look if it is moved around or its parts are rearranged.
- Quickly and accurately compare letters, numbers, objects, pictures, or patterns.

Working Conditions

In a typical work setting, precision agriculture technicians:

INTERPERSONAL RELATIONSHIPS

- Have a medium level of social interaction.
- Usually talk to others by e-mail, phone, or in person. They sometimes write letters and memos.
- Sometimes work as part of a team.
- Are somewhat responsible for the work done by others.
- Have limited responsibility for the health and safety of others.

PHYSICAL WORK CONDITIONS

- Usually work outdoors.
- Sometimes work indoors, usually when analyzing data. These locations may not be temperature-controlled.
- Are sometimes exposed to hot or cold temperatures, depending on the weather.
- Often travel around work sites in a truck, tractor, or other farm vehicle.

WORK PERFORMANCE

- Must be very exact and accurate when analyzing data and making decisions.
- Usually do not consult a supervisor before making a decisions or setting tasks and goals.
- Meet strict weekly deadlines. This makes the work atmosphere somewhat competitive.
- Weekly make decisions that strongly impact coworkers and their company.
- Repeat the same mental and physical tasks.

HOURS / TRAVEL

- Usually work a standard work week, but their schedule may vary due to weather or to harvest, planting, and related schedules.

Physical Demands

Precision agriculture technicians frequently:

- Sit for long periods of time.

It is important for precision agriculture technicians to be able to:

- See details of objects whether they are nearby or far away.
- Speak clearly so listeners can understand.
- Understand the speech of another person.
- Make quick, precise adjustments to machine controls.
- Use fingers or hands to grasp, move, or assemble very small objects.
- Hold the arm and hand in one position or hold the hand steady while moving the arm.

It is not as important, but still necessary, for precision agriculture technicians to be able to:

- Move arms and legs quickly.
- Determine the distance between objects.
- See differences between colors, shades, and brightness.
- Hear sounds and recognize the difference between them.
- Use stomach and lower back muscles to support the body for long periods without getting tired.
- Choose quickly and correctly among various movements when responding to different signals.
- Use muscles to lift, push, pull, or carry heavy objects.
- Make fast, repeated movements of fingers, hands, and wrists.
- Bend, stretch, twist, or reach out.
- Adjust body movements or equipment controls to keep pace with speed changes of moving objects.
- Coordinate movement of several parts of the body, such as arms and legs, while the body is moving.
- React quickly using hands, fingers, or feet.
- Be physically active and use muscles for long periods without getting tired or out of breath.
- Focus on one source of sound and ignore others.

Knowledge

Precision agriculture technicians need knowledge in the following areas:

- Computers and Electronics: Knowledge of computer hardware and software.
- Customer and Personal Service: Knowledge of providing special services to customers based on their needs.
- Mathematics: Knowledge of the rules and uses of numbers. Areas of knowledge include arithmetic, algebra, geometry, and statistics.
- English Language: Knowledge of the meaning, spelling, and use of the English language.
- Biology: Knowledge of plants, animals, and living organisms and how they function.
- Food Production: Knowledge of planting, growing, and harvesting food for eating.
- Geography: Knowledge of land, sea, and air masses. Also includes knowledge of how to describe their location, features, and relationships.
- Clerical: Knowledge of general office work such as filing and recording information.
- Engineering and Technology: Knowledge of how to build machines, buildings, and other things. Also includes knowledge of how to use computers, machines, and tools to do work more usefully.

Interests

Precision agriculture technicians are people who tend to:

- Consider good working conditions important. They like jobs offering steady employment and good pay. They want employment that fits their individual work style. They may prefer doing a variety of tasks, working alone, or being busy all the time.
- Consider independence important. They like to make decisions and try out ideas on their own. They prefer jobs where they can plan their work with little supervision.
- Consider achievement important. They like to see the results of their work and to use their strongest abilities. They like to get a feeling of accomplishment from their work.
- Consider support from their employer important. They like to be treated fairly and have supervisors who will back them up. They prefer jobs where they are trained well.
- Have realistic interests. They like work activities that include practical, hands-on problems and solutions. They like to work with plants, animals, and physical materials such as wood, tools, and machinery. They often prefer to work outside.
- Have investigative interests. They like work activities that have to do with ideas and thinking. They like to search for facts and figure out solutions to problems mentally.
- Have conventional interests. They like work activities that follow set procedures, routines, and standards. They like to work with data and detail. They prefer working where there is a clear line of authority to follow.

Occupational Interest Codes

- RIC

Wages

Wages vary by employer and area of the country. The individual's specialty and level of experience and responsibility also affect wages. Those who have supervisory duties usually earn higher wages.

Precision agriculture technicians who work full time usually receive benefits. Typical benefits include sick leave, paid vacation, and health insurance. Some employers also provide a retirement plan.

Location	Pay Period	25%	Median	75%
Hawai'i	Hourly	$17.98	$23.73	$31.80
	Yearly	$37,410	$49,350	$66,140
Honolulu	Hourly	$18.85	$26.15	$32.71
	Yearly	$39,210	$54,390	$68,030
United States	Hourly	$15.39	$20.24	$26.45
	Yearly	$32,010	$42,110	$55,020

Outlook

In Hawai'i and nationally, outlook information is not available specifically for precision agriculture

technicians. However, they are part of a larger group of "life, physical, and social sciences technicians, all other." Little change in employment is expected for workers in this group through 2018.

The table below provides information about the number of workers in this occupation in various regions. It also provides information about the expected growth rate and future job openings.

EMPLOYMENT

Major employers:
- Consulting firms
- Federal, state, and local government agencies

OUTLOOK

The growing number of people in the world will increase demands for food and energy. Precision agriculture technicians will be needed to find better ways to produce food. They will also work to save natural resources such as soil, air, and water. Opportunities will be best for technicians with strong technical, computing, and communication skills.

The use of advanced technologies, such as GPS, and GIS, will continue to increase both the accuracy and productivity of these workers. This will limit job growth to some extent. However, job openings will continue to arise from the need to replace workers who leave this occupation.

	Employment		Employment Change	
	2008	2018	Number	Percent
National	64,700	73,300	8,600	13.3
State	430	430	0	0.0

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later. If you attend a private school, check with your school counselor for graduation requirements.

You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Agronomy
- Algebra
- Computer Applications
- Computer-Assisted Design (CAD)
- Computer Science
- Geography
- Keyboarding
- Plant and Soil Science

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and

groups that may be available in your high school or community can be found at http://www.careerkokua.org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Preparation

To work as a precision agriculture technician, you must:

- have a high school diploma or GED;
- complete a certificate or two-year associate degree;
- have practical, hands-on skills;
- have good computer skills; and
- have good communication skills.

EDUCATION AFTER HIGH SCHOOL

Most people prepare for this occupation by getting a certificate or associate degree in this field. Certificates typically take one year to complete while associate's degrees usually take two. Many community colleges and vocational schools offer one-year programs in this field.

Because this degree combines two distinct fields, it is becoming more common for schools to offer bachelor's degrees in precision agriculture.

WORK EXPERIENCE

Working in jobs that give you practical experience in the areas you wish to work is good background for this occupation. The fields of civil engineering and geography are very helpful as they focus on use of the Geographic Information Software (GIS). Work in a farm or ranch setting is helpful, too.

ON-THE-JOB TRAINING

As a new technician, you perform routine tasks while closely supervised by an experienced technician or agricultural engineer. As you gain experience, you work on tasks that are more difficult. Training may last a month up to a year.

Related Educational Programs

- Agricultural Business and Production
- Construction Trades
- Drafting/Design Technologies
- Engineering
- Engineering Technologies
- Geography
- Geological and Earth Sciences
- Physics

Hiring Practices

Employers look for precision agriculture technicians who have at least a one-year degree in this field. Employers also look for applicants with strong technical, computing, and mechanical skills. Good communication skills are very important because technicians work with engineers and other team members. An interest in math, science, and farming is also important.

Advancement Opportunities

Precision agriculture technicians usually begin by doing routine duties. They work under the close supervision of experienced technicians, technologists, or managers. As they gain experience, technicians are given more difficult assignments and have less supervision. Precision agriculture technicians with leadership skills may advance to supervisor positions. Keeping their skills current through continuing education classes helps technicians to advance.

Additional Sources of Information

- Hawai'i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai'i Career Information Delivery System, www.careerkokua.org

Regulatory Affairs Managers

At a Glance

- Usually have at least a bachelor's degree
- Are very organized and detail-oriented
- Usually work with specialists and scientists
- Sit for long periods of time
- Often work in the pharmaceutical and medical fields
- Earn $74,840 per year (Hawai'i median)

Overview

Regulatory affairs managers plan and direct applications to regulatory agencies to get a new product approved. They also make sure that existing products meet all rules and guidelines.

Many products and services cannot be offered to the public until complex regulatory processes are complete. This is because consumer safety must be protected. As our technology and medicines grow more complicated, so do regulations. Regulatory affairs managers help companies and organizations meet these requirements as efficiently as possible.

Regulatory affairs have two broad categories. The first is getting regulatory approval, and the second is keeping it. Both categories require managers to be very organized and detail-oriented. In all cases, extensive documentation, planning, and coordination are needed. Applications for a new product or medicine require complete accuracy and timeliness. Managers work with scientists, designers, managers, directors, technicians, and other staff to put together a solid application. For certain products, especially medicines, an application occurs in several stages, often over several years.

Regulations often change, and government agencies require regular updates to make sure that companies are following the rules. Regulatory affairs managers must constantly monitor government regulations for deadlines and changes. If a product or service is out of compliance, managers must act quickly to make the necessary changes and submit the proper documentation. Regulatory affairs managers must create their own internal processes to keep all reporting and status changes up-to-date.

Federal, state, and local agencies routinely conduct audits or inspections of companies to inspect their files and processes. Regulatory affairs managers manage these audits from the company's side to make sure inspectors and auditors have everything they need.

The green sector of the economy is creating many new technologies that must be approved for use. Companies need to receive approval for new technologies and also must stay current on new regulations as they are created. As a result, there will likely be increased demand in the green sector of the economy for regulatory affairs managers in the future.

Specific Work Activities

The following list of occupational tasks is specific to regulatory affairs managers.

- Direct the preparation and submission of regulatory agency applications, reports, or correspondence.
- Review all submission materials to ensure timeliness, accuracy, completeness, and compliance with regulatory standards.
- Provide regulatory guidance to departments or project teams regarding design, development, evaluation, or marketing of products.
- Create or implement regulatory affairs policies and procedures to ensure compliance.
- Communicate regulatory information to departments and ensure that information is interpreted correctly.
- Manage activities such as audits, regulatory agency inspections, and product recalls.

- Develop strategies and plans for the preparation and submission of new products.
- Provide responses to regulatory agencies regarding product information or issues.
- Maintain current knowledge of regulations including proposed and final rules.
- Investigate product complaints and prepare documentation and submissions to appropriate regulatory agencies as necessary.

Common Work Activities

Regulatory affairs managers perform the following list of tasks, but the tasks are common to many occupations.

- Evaluate information against standards.
- Get information needed to do the job.
- Communicate with supervisors, peers, or subordinates.
- Communicate with people from outside the organization.
- Update and use job-related knowledge.
- Organize, plan, and prioritize work.
- Establish and maintain relationships.
- Make decisions and solve problems.
- Document and record information.
- Explain the meaning of information to others.
- Use computers.
- Develop goals and strategies.
- Resolve conflicts and negotiate with others.
- Analyze data or information.
- Identify objects, actions, and events.
- Process information.
- Schedule work and activities.
- Develop and build teams.
- Coordinate the work and activities of others.
- Provide advice and consultation to others.

Related Occupations

This occupation is part of the **Business, Management and Administration** cluster of occupations.

Related occupations include:
- Compliance Officers and Inspectors
- Regulatory Affairs Specialists

Hawai'i Career Pathways:
- Business, Management & Technology

Related O*NET Specialties:
- Regulatory Affairs Managers

Skills and Abilities

Regulatory affairs managers need to:

COMMUNICATE

- Understand written and spoken information.
- Express ideas clearly when speaking or writing.

REASON AND PROBLEM SOLVE

- Notice when something is wrong or is likely to go wrong.
- Use reasoning to discover answers to problems.
- Combine several pieces of information and draw conclusions.
- Develop rules or follow guidelines when arranging items
- Think of new ideas or original and creative ways to solve problems.
- Concentrate and not be distracted while performing a task.

Working Conditions

In a typical work setting, regulatory affairs managers:

INTERPERSONAL RELATIONSHIPS

- Have a high level of social interaction. They interact with managers, scientists, and specialists throughout the day.
- Regularly work as part of a team.
- Communicate by telephone, e-mail, letters, memos, and in person on a daily basis.
- Are occasionally placed in conflict situations.

PHYSICAL WORK CONDITIONS

- Work indoors.

WORK PERFORMANCE

- Must be very exact and extremely accurate in their work. Errors could significantly delay a product approval or even cause a product to lose its regulatory status.
- Usually set their daily tasks and goals or make decisions without consulting a superior first. Their work is dependent on what scientists do and by upcoming deadlines, so working together is very important.
- Weekly make decisions that strongly impact their co-workers and their company.
- Must meet strict weekly deadlines that may make the work environment somewhat stressful.
- Repeat the same mental and physical tasks.

HOURS / TRAVEL

- Usually work a standard work week, but overtime is common when deadlines are near.

Physical Demands

Regulatory affairs managers frequently:

- Sit for long periods of time.

It is important for regulatory affairs managers to be able to:

- Speak clearly so listeners can understand.
- Understand the speech of another person.
- See details of objects that are less than a few feet away.

It is not as important, but still necessary, for regulatory affairs managers to be able to:

- See details of objects that are more than a few feet away.
- Hear sounds and recognize the difference between them.
- See differences between colors, shades, and brightness.

Knowledge

Regulatory affairs managers need knowledge in the following areas:

- Law, Government, and Jurisprudence: Knowledge of laws, rules, court procedures, and the political process.
- English Language: Knowledge of the meaning, spelling, and use of the English language.
- Medicine and Dentistry: Knowledge of injuries, illnesses, and defects. Also includes the knowledge of setting up a plan for treatment.
- Administration and Management: Knowledge of managing the operations of a business, company, or group.
- Biology: Knowledge of plants, animals, and living organisms and how they function.
- Clerical: Knowledge of general office work such as filing and recording information.
- Education and Training: Knowledge of teaching and the methods involved in learning and instruction.
- Chemistry: Knowledge of the properties of substances and the changes that occur when they interact.
- Customer and Personal Service: Knowledge of providing special services to customers based on their needs.
- Computers and Electronics: Knowledge of computer hardware and software.

Interests

Regulatory affairs managers are people who tend to:

- Consider achievement important. They like to see the results of their work and to use their strongest abilities. They like to get a feeling of accomplishment from their work.
- Consider independence important. They like to make decisions and try out ideas on their own. They prefer jobs where they can plan their work with little supervision.
- Consider good working conditions important. They like jobs offering steady employment and good pay. They want employment that fits their individual work style. They may prefer doing a variety of tasks, working alone, or being busy all the time.
- Consider support from their employer important. They like to be treated fairly and have supervisors who will back them up. They prefer jobs where they are trained well.

- Consider recognition important. They like to work in jobs which have opportunities for them to advance, be recognized for their work, and direct and instruct others. They usually prefer jobs in which they are looked up to by others.
- Have enterprising interests. They like work activities that involve starting up and carrying out projects, especially in business. They like to lead and persuade others, make decisions, and take risks for profit.
- Have conventional interests. They like work activities that follow set procedures, routines, and standards. They like to work with data and detail. They prefer working where there is a clear line of authority to follow.

OCCUPATIONAL INTEREST CODES

- EC

Wages

Wages vary widely by employer and area of the country. Wages may also vary depending on the difficulty of projects and level of responsibility.

Benefits also vary by employer. Most regulatory affairs managers receive typical benefits. These include vacation, sick leave, and health insurance.

Location	Pay Period	25%	Median	75%
Hawai'i	Hourly	$24.83	$35.98	$50.33
	Yearly	$51,640	$74,840	$104,690
Honolulu	Hourly	$25.42	$36.89	$49.99
	Yearly	$52,870	$76,730	$103,980
United States	Hourly	$31.78	$44.52	$59.22
	Yearly	$66,110	$92,600	$123,190

Outlook

In Hawai'i and nationally, outlook information is not available specfically for regulatory affairs managers. However, they are included in a larger group of "managers, all other." Slower than average employment growth is expected for workers in this group through 2018.

The table below provides information about the number of workers in this occupation in various regions. It also provides information about the expected growth rate and future job openings.

EMPLOYMENT

Major employers:

- Drug manufacturers
- Federal, state, and local government agencies
- Research and testing companies

OUTLOOK

Much of the job growth for regulatory affairs managers will be due to the growing green sector of the economy. As more regulations are designed to make our products and medicines more environmentally friendly, the need for managers to oversee these rules will grow. Regulatory affairs managers will be needed to work with organizations that enforce regulations and offer policy analysis related to environmental concerns. They will also be needed to work closely with public and private organizations that focus on conservation and pollution prevention.

	Employment		Employment Change	
	2008	2018	Number	Percent
National	898,200	964,000	65,800	7.3
State	3,830	3,990	160	4.2

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011

or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later. If you attend a private school, check with your school counselor for graduation requirements.

You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Anatomy and Physiology
- Biology
- Business and Applied English
- Chemistry
- Consumer Law
- Computer Applications
- Keyboarding
- Marketing

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and groups that may be available in your high school or community can be found at http://www.careerkokua.org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Preparation

To work as a regulatory affairs manager, you must:

- have a high school diploma or GED;
- complete a bachelor's degree in a related field;
- be a skilled writer;
- be organized; and
- have good judgment.

EDUCATION AFTER HIGH SCHOOL

Most regulatory affairs managers have a bachelor's degree. You need a degree in a life science, typically biology, to work in the medical industry. To work in manufacturing, you need a degree in engineering or even business.

It is becoming more common for schools to offer one-year certificate programs in regulatory affairs. These programs are designed for those with a bachelor's degree and several years of experience in regulatory affairs. They may also be part of a master's program. Those with a background in pharmacy often decide to supplement their education with this type of certificate.

WORK EXPERIENCE

Usually you must prove yourself as a regulatory affairs specialist before you can become a manager. Most regulatory affairs managers work for several years as specialists before becoming managers.

ON-THE-JOB TRAINING

You should consider participating in an internship while in college. An internship is usually part of a four-year degree program. It offers you a chance to apply what you have learned in the classroom to a work situation. It also allows you to build skills and make contacts with people in the field.

Many large firms provide training to new employees so they can learn that particular company's regulatory needs. You may spend time studying a particular industry or product. Training may last up to three months.

Related Educational Programs

- Accounting
- Biological Sciences
- Business Management and Administration
- Chemistry
- Engineering
- Public Health

Hiring Practices

Employers usually seek college graduates to fill entry-level jobs in regulatory affairs. Many employers prefer applicants who have majored in biology, chemistry, or another related degree. Many employers prefer graduates who have work experience in research laboratories. Other employers outside the medical field seek applicants with a background in business, manufacturing, or engineering. Applicants who have experience from an internship are also attractive.

Employers especially seek regulatory affairs managers who can speak and write effectively. Employers look for a combination of experience, education, and organizational skills. They seek managers who can cope well with pressure or conflict.

Most employers require managers to have several years of direct, related work experience in regulatory affairs. In many cases, companies hire their own employees who have worked first as specialists. A master's degree is also becoming more common.

Advancement Opportunities

Most regulatory affairs managers advance into this work from a specialist or entry-level position. Getting certified in regulatory affairs is often a key part of advancement into manager-level work.

As regulatory affairs managers gain additional experience, they are given more difficult projects and more responsibility. Those with leadership skills may move up to manage teams of specialists and other related workers.

Additional Sources of Information

- Hawai'i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai'i Career Information Delivery System, www.careerkokua.org

Regulatory Affairs Specialists

At a Glance

- Assist regulatory affairs managers with new product approvals
- Compose many types of documents
- May work overtime to meet project deadlines
- Are detail-oriented and organized
- Earn $40,530 per year (Hawai‘i median)

Overview

Regulatory affairs specialists assist managers in getting new products approved by a regulatory agency. They also maintain records on existing products.

Regulatory affairs specialists work with regulatory affairs managers to help companies manage all aspects of complying with regulations. This includes many tasks, such as submitting regular reports for existing products. Specialists also help companies meet regulations for new products. This is a very complex task. For example, agencies might require that a product be made in a certain way and have very specific statements printed on the product label. Products also need testing to ensure that they meet health and safety standards.

Regulations often change, so specialists must stay up-to-date. They must communicate changes to managers, directors, supervisors, and employees. They often document changes in memos, reports, manuals, and guides. When a product is changed regulatory affairs specialists must make reports to agencies to make sure their companies comply with all rules, regulations, and applicable laws. They must be able to respond to requests for more information, as agencies frequently ask questions or for more documentation.

Regulatory affairs specialists must be highly organized, detail-oriented, and good writers. Keeping complete, updated records is a key part of this job.

Specific Work Activities

The following list of occupational tasks is specific to regulatory affairs specialists.

- Coordinate, prepare, or review regulatory submissions.
- Provide technical review of data or reports that will be incorporated into regulatory submissions to assure scientific rigor, accuracy, and clarity of presentation.
- Review product materials, labeling, records, specification sheets, or test methods to make sure they meet regulations.
- Maintain knowledge of existing and emerging regulations, standards, or guidance documents.
- Interpret regulatory rules or rule changes and ensure that they are communicated to other workers.
- Determine what kinds of regulatory submissions or documentation is needed when changing devices or labeling.
- Advise project teams about pre-market regulatory requirements, export and labeling requirements, and clinical study issues.
- Prepare or maintain files to obtain and sustain product approval.
- Coordinate the preparation of regulatory documents or submissions.
- Prepare or direct the preparation of additional information or responses as requested by regulatory agencies.

Common Work Activities

Regulatory affairs specialists perform the following list of tasks, but the tasks are common to many occupations.

- Evaluate information against standards.
- Get information needed to do the job.
- Update and use job-related knowledge.
- Use computers.
- Communicate with supervisors, peers, or subordinates.
- Organize, plan, and prioritize work.

- Process information.
- Explain the meaning of information to others.
- Establish and maintain relationships.
- Communicate with people from outside the organization.
- Make decisions and solve problems.
- Document and record information.
- Identify objects, actions, and events.
- Analyze data or information.
- Perform administrative tasks.
- Develop goals and strategies.
- Provide advice and consultation to others.
- Coordinate the work and activities of others.
- Develop and build teams.
- Schedule work and activities.

Related Occupations

This occupation is part of the **Business, Management and Administration** cluster of occupations.

Related occupations include:
- Compliance Officers and Inspectors
- Regulatory Affairs Managers

Hawai'i Career Pathways:
- Business, Management & Technology

Related O*NET Specialties:
- Regulatory Affairs Specialists

Skills and Abilities

Regulatory affairs specialists need to:

COMMUNICATE

- Understand written or spoken information.
- Express ideas clearly when speaking or writing.

REASON AND PROBLEM SOLVE

- Notice when something is wrong or is likely to go wrong.
- Combine several pieces of information and draw conclusions.
- Develop rules or follow guidelines when arranging items.
- Use reasoning to discover answers to problems.
- Think of new ideas or original and creative ways to solve problems.

PERCEIVE AND VISUALIZE

- Identify a pattern (a figure, object, word, or sound) that is hidden in distracting material.
- Quickly and accurately compare letters, numbers, objects, pictures, or patterns.

Working Conditions

In a typical work setting, regulatory affairs specialists:

INTERPERSONAL RELATIONSHIPS

- Have a medium level of social interaction. They spend time working with managers and scientists, but also spend time writing reports and organizing data.
- Communicate daily by telephone, e-mail, and in face-to-face discussions. They also write letters and memos frequently.
- Are occasionally placed in conflict situations.
- Work as part of a project team.

PHYSICAL WORK CONDITIONS

- Work indoors.
- May share office space with other specialists.

WORK PERFORMANCE

- Must be very exact and extremely accurate in their work. Errors could significantly delay a product approval or even cause a product to lose its regulatory status.
- Usually set their daily tasks and goals or make decisions without consulting a superior first. They work with regulatory affairs managers, so they often seek feedback from them about major tasks.
- Weekly make decisions that strongly impact their co-workers and their company.
- Must meet strict weekly deadlines that may make the work environment somewhat stressful.
- Repeat the same mental and physical tasks.

HOURS / TRAVEL

- Typically work a standard work week, but overtime is common when deadlines are approaching.

Physical Demands

Regulatory affairs specialists frequently:

- Sit for long periods of time.

It is not as important, but still necessary, for regulatory affairs specialists to be able to:

- See details of objects that are more than a few feet away.
- Use fingers to grasp, move, or assemble very small objects.
- Focus on one source of sound and ignore others.
- See differences between colors, shades, and brightness.
- Hear sounds and recognize the difference between them.

Knowledge

Regulatory affairs specialists need knowledge in the following areas:

- English Language: Knowledge of the meaning, spelling, and use of the English language.
- Law, Government, and Jurisprudence: Knowledge of laws, rules, court procedures, and the political process.
- Clerical: Knowledge of general office work such as filing and recording information.

Interests

Regulatory affairs specialists are people who tend to:

- Consider good working conditions important. They like jobs offering steady employment and good pay. They want employment that fits their individual work style. They may prefer doing a variety of tasks, working alone, or being busy all the time.
- Consider independence important. They like to make decisions and try out ideas on their own. They prefer jobs where they can plan their work with little supervision.
- Consider achievement important. They like to see the results of their work and to use their strongest abilities. They like to get a feeling of accomplishment from their work.
- Consider support from their employer important. They like to be treated fairly and have supervisors who will back them up. They prefer jobs where they are trained well.
- Consider recognition important. They like to work in jobs which have opportunities for them to advance, be recognized for their work, and direct and instruct others. They usually prefer jobs in which they are looked up to by others.
- Have conventional interests. They like work activities that follow set procedures, routines, and standards. They like to work with data and detail. They prefer working where there is a clear line of authority to follow.
- Have enterprising interests. They like work activities that involve starting up and carrying out projects, especially in business. They like to lead and persuade others, make decisions, and take risks for profit.

Occupational Interest Codes

- CE

Wages

Wages vary widely depending on the specialist's skill level, experience, and level of education. Wages also vary by area of the country and by employer.

Benefits also vary. Most full-time regulatory affairs specialists receive typical benefits. These include paid vacation, sick leave, and health insurance.

Location	Pay Period	25%	Median	75%
Hawai'i	Hourly	$14.93	$19.49	$28.56
	Yearly	$31,040	$40,530	$59,410
Honolulu	Hourly	$14.56	$21.77	$32.09
	Yearly	$30,280	$45,270	$66,750
United States	Hourly	$17.83	$23.92	$32.54
	Yearly	$37,080	$49,750	$67,680

Outlook

In Hawai'i and nationally, outlook information for regulatory affairs specialists is not available. However, they are part of a larger group of "compliance officers, except agriculture, construction, health and safety, and transportation." Much faster than average employment growth is expected for workers in this group through 2018.

The table below provides information about the number of workers in this occupation in various regions. It also provides information about the expected growth rate and future job openings.

EMPLOYMENT

Major employers:
- Drug manufacturers
- Federal, state, and local government agencies
- Research and testing companies

OUTLOOK

Much of the job growth for regulatory affairs specialists will be due to the growing green sector of the economy. As more regulations are designed to make our products and medicines more environmentally friendly, the need for specialists will grow. Regulatory affairs specialists will be needed to work with organizations that enforce regulations and offer policy analysis related to environmental concerns. They will also be needed to work closely with public and private organizations that focus on conservation and pollution prevention.

	Employment		Employment Change	
	2008	2018	Number	Percent
National	260,200	341,000	80,800	31.1
State	2,940	3,610	670	22.8

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later. If you attend a private school, check with your school counselor for graduation requirements.

You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Anatomy and Physiology
- Biology
- Business and Applied English
- Chemistry
- Consumer Law
- Computer Applications
- Keyboarding
- Marketing

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn

about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and groups that may be available in your high school or community can be found at http://www.careerkokua.org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Preparation

To work as a regulatory affairs specialist, you must:

- have a high school diploma or GED;
- have a bachelor's degree;
- be organized;
- be a skilled writer; and
- have good judgment.

Education After High School

Most regulatory affairs specialists have a bachelor's degree. You need a degree in a life science, typically biology, to work in the medical industry. To work in manufacturing, you need a degree in engineering or even business.

On-the-Job Training

Many large firms provide training to new employees. You usually work with experienced specialists or managers on smaller projects or standard regulatory submission work, such as preparing updates for regulatory agencies. This type of training can last anywhere from one month to a year.

Consider participating in an internship while you are in college. An internship offers you a chance to apply what you learned in the classroom to a work situation. It also allows you to build skills and make contacts with people in the field.

Related Educational Programs

- Accounting
- Biological Sciences
- Business Management and Administration
- Chemistry
- Engineering
- Public Health

Hiring Practices

Employers usually seek college graduates to fill entry-level jobs in regulatory affairs. Many employers prefer applicants who have majored in biology, chemistry, or another related degree. Many employers prefer graduates who have work experience in research laboratories. Other employers outside the medical field seek applicants with a background in business, manufacturing, or engineering. Applicants who have experience from an internship are also attractive.

Employers especially seek regulatory affairs specialists who can speak and write effectively. Employers look for a combination of education and organizational skills. They seek specialists who can work independently and under deadline.

Advancement Opportunities

At large companies, new graduates usually work under the supervision of experienced regulatory affairs managers. Certification in regulatory affairs in addition to work experience will often make specialists eligible for managerial positions.

In general, as regulatory affairs specialists gain experience, they are given more difficult projects and the independence to lead parts of a larger product submission. They may begin by reviewing existing, approved products and move into helping new products gain FDA or other agency approval.

Additional Sources of Information

- Hawai'i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai'i Career Information Delivery System, www.careerkokua.org

Remote Sensing Scientists and Technologists

At a Glance

- Use Geographic Information Systems (GIS), aerial photography, and satellite images
- Most have a bachelor's degree
- Work in a variety of fields
- Sit for a long period of time
- Earn $74,070 per year (Hawai'i median)

Overview

Remote sensing scientists and technologists use aerial photography, satellite images, Global Positioning Systems (GPS), and Geographic Information Systems (GIS) to analyze data and solve problems.

Remote sensing scientists and technologists use aerial photography (taking photos from an airplane) and satellite photography to gather information. They do this to determine the features of an area, what kind of resources it may have, or its general size and shape. This data is often analyzed using GIS software. Remote sensing is important because it is extremely accurate and allows data and images to be collected from places that can't be reached any other way. It can also detect information that the human eye can't see, such as surface temperatures.

There are many uses for this data, especially in mapping and surveying. Beyond this, remote sensing technologists and scientists work in the fields of agriculture, geography, hydrology, and oceanography. They also work in applied mathematics, meteorology, and environmental science. Because remote sensing technology is so complex and sophisticated, employers need technicians and scientists who concentrate on this alone.

To work in this field, you must be very good at math, science (including physics), and computer programming. Math and science skills are needed to analyze data and apply it to a particular situation or project. Computing skills are essential because most remote sensing uses statistical software and GIS. Remote sensing scientists and technologists must be able to input data, retrieve it, determine the results, and recommend what to do based on the data.

Remote sensing is used extensively by the green sector of the economy. Consulting firms and research institutions use remote sensing in renewable energy projects and to develop new environmentally friendly technologies. As a result, there will likely be increased demand in the green sector for remote sensing scientists and technologists in the future.

Specific Work Activities

The following list of occupational tasks is specific to remote sensing scientists and technologists.

- Analyze data acquired from aircraft, satellites, or ground-based equipment using statistical analysis software, image analysis software, or Geographic Information Systems (GIS).
- Analyze and organize data obtained from remote sensing systems.
- Process aerial and satellite imagery to create products such as landcover maps.
- Develop and build databases for remote sensing and related geospatial project information.
- Monitor quality of remote sensing data collection to see if changes are necessary.
- Attend meetings or seminars and read current literature to maintain knowledge of developments in the field of remote sensing.
- Prepare and deliver reports and presentations of geospatial project information.
- Conduct research into the application and enhancement of remote sensing technology.
- Discuss project goals, equipment requirements, and methodologies with colleagues and team members.
- Integrate other geospatial data sources into projects.

Common Work Activities

Remote sensing scientists and technologists perform the following list of tasks, but the tasks are common to many occupations.

- Use computers.
- Analyze data or information.
- Process information.
- Update and use job-related knowledge.
- Identify objects, actions, and events.
- Get information needed to do the job.
- Organize, plan, and prioritize work.
- Make decisions and solve problems.
- Communicate with supervisors, peers, or subordinates.
- Document and record information.
- Think creatively.
- Explain the meaning of information to others.
- Communicate with people from outside the organization.
- Estimate sizes, quantities, time, cost, or materials needed.
- Establish and maintain relationships.
- Provide advice and consultation to others.
- Teach others.
- Coordinate the work and activities of others.
- Evaluate information against standards.
- Schedule work and activities.

Related Occupations

This occupation is part of the **Science, Technology, Engineering, and Mathematics** cluster of occupations.

Related occupations include:
- Cartographers and Photogrammetrists
- Geographic Information Systems Specialists
- Geologists and Geophysicists
- Geospatial Information Scientists and Technologists
- Surveyors

Hawai'i Career Pathways:
- Industrial & Engineering Technology

Related O*NET Specialties:
- Remote Sensing Scientists and Technologists

Skills and Abilities

Remote sensing scientists and technologists need to:

COMMUNICATE

- Understand spoken and written information.
- Express ideas clearly when speaking or writing.

REASON AND PROBLEM SOLVE

- Combine several pieces of information and draw conclusions.
- Notice when something is wrong or is likely to go wrong.
- Use reasoning to discover answers to problems.
- Develop rules or follow guidelines when arranging items in a certain order.
- Think of new ideas or original and creative ways to solve problems.
- Concentrate and not be distracted while performing a task.

USE MATH AND SCIENCE

- Choose a mathematical method or formula to solve problems.

PERCEIVE AND VISUALIZE

- Identify a pattern (a figure, object, word, or sound) that is hidden in distracting material.
- Quickly and accurately compare letters, numbers, objects, pictures, or patterns.
- Imagine how something will look if it is moved around or its parts are rearranged.

Working Conditions

In a typical work setting, remote sensing scientists and technologists:

INTERPERSONAL RELATIONSHIPS

- Have a low level of social interaction.
- Usually communicate via phone, e-mail, or in-person conversations.

- Have limited responsibility for the work done by others.
- Often work as part of a project team.

PHYSICAL WORK CONDITIONS

- Work mostly indoors, but occasionally work outdoors.

WORK PERFORMANCE

- Must be very exact and accurate when interpreting images and data.
- Usually do not consult a supervisor before making a decisions or setting tasks and goals.
- Meet strict daily and weekly deadlines. This makes the work atmosphere somewhat competitive.
- Often make decisions that strongly impact coworkers and their company.
- Repeat the same physical and mental activities.

HOURS / TRAVEL

- Usually work a standard work week.

Physical Demands

Remote sensing scientists and technologists frequently:
- Sit for long periods of time.

It is important for remote sensing scientists and technologists to be able to:

- See details of objects that are less than a few feet away.
- Speak clearly so listeners can understand.
- Understand the speech of another person.
- Use fingers to grasp, move, or assemble very small objects.

It is not as important, but still necessary, for remote sensing scientists and technologists to be able to:

- See differences between colors, shades, and brightness.
- Hold the arm and hand in one position or hold the hand steady while moving the arm.
- Use one or two hands to grasp, move, or assemble objects.
- Hear sounds and recognize the difference between them.
- Make quick, precise adjustments to machine controls.

Knowledge

Remote sensing scientists and technologists need knowledge in the following areas:

- Geography: Knowledge of land, sea, and air masses. Also includes knowledge of how to describe their location, features, and relationships.
- Computers and Electronics: Knowledge of computer hardware and software.
- Mathematics: Knowledge of the rules and uses of numbers. Areas of knowledge include arithmetic, algebra, geometry, and statistics.
- English Language: Knowledge of the meaning, spelling, and use of the English language.
- Engineering and Technology: Knowledge of how to build machines, buildings, and other things. Also includes knowledge of how to use computers, machines, and tools to do work more usefully.
- Physics: Knowledge of the features and rules of matter and energy. Areas of knowledge include air, water, light, heat, weather, and other natural events.

Interests

Remote sensing scientists and technologists are people who tend to:

- Consider achievement important. They like to see the results of their work and to use their strongest abilities. They like to get a feeling of accomplishment from their work.
- Consider recognition important. They like to work in jobs which have opportunities for them to advance, be recognized for their work, and direct and instruct others. They usually prefer jobs in which they are looked up to by others.
- Consider independence important. They like to make decisions and try out ideas on their own. They prefer jobs where they can plan their work with little supervision.

- Consider good working conditions important. They like jobs offering steady employment and good pay. They want employment that fits their individual work style. They may prefer doing a variety of tasks, working alone, or being busy all the time.
- Consider support from their employer important. They like to be treated fairly and have supervisors who will back them up. They prefer jobs where they are trained well.
- Have realistic interests. They like work activities that include practical, hands-on problems and solutions. They like to work with plants, animals, and physical materials such as wood, tools, and machinery. They often prefer to work outside.
- Have investigative interests. They like work activities that have to do with ideas and thinking. They like to search for facts and figure out solutions to problems mentally.

OCCUPATIONAL INTEREST CODES

- RI

Wages

Wages vary by employer and area of the country. The individual's specialty and level of experience and responsibility also affect wages. Those who have supervisory duties usually earn higher wages.

Remote sensing scientists and technologists who work full time usually receive benefits. Typical benefits include sick leave, paid vacation, and health insurance. Some employers also provide a retirement plan.

Location	Pay Period	25%	Median	75%
Hawai'i	Hourly	$26.92	$35.61	$48.08
	Yearly	$55,990	$74,070	$100,000
Honolulu	Hourly	$28.19	$36.87	$49.52
	Yearly	$58,640	$76,700	$103,000
United States	Hourly	$33.27	$45.17	$57.61
	Yearly	$69,210	$93,950	$119,840

Outlook

In Hawai'i, outlook information is not available specifically for remote sensing scientists and technologists. However, they are part of a larger group of "physical scientists, all other." Little change in employment is expected for workers in this group through 2018.

Nationally, employment of workers in this group is expected to grow as fast as the average through 2018.

The table below provides information about the number of workers in this occupation in various regions. It also provides information about the expected growth rate and future job openings.

EMPLOYMENT

Major employers:
- Consulting firms
- Local, state, and federal government agencies

OUTLOOK

Much of the job growth for remote sensing scientists and technologists will be due to the growing green sector of the economy. Remote sensing will be used as part of energy consulting and research into developing new environmentally friendly technologies and ideas. Opportunities will be best for scientists and technologists with strong technical, computing, and communication skills.

The use of advanced technologies, such as GPS, GIS, and remote sensing, will continue to increase both the accuracy and productivity of these workers. This will limit job growth to some extent. However, job openings will continue to arise from the need to replace workers who leave this occupation.

	Employment		Employment Change	
	2008	2018	Number	Percent
National	27,400	30,400	3,000	11.1
State	110	110	0	0.0

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later. If you attend a private school, check with your school counselor for graduation requirements.

Remote sensing scientists and technologists need a strong background in math and science. Try to take math classes through Trigonometry and science classes through Physics.

You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Computer Applications
- Computer Programming
- Computer Science
- Economics
- Geography
- Keyboarding

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and groups that may be available in your high school or community can be found at http://www.careerkokua.org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Preparation

To work as a remote sensing technologist, you must:

- have a high school diploma or GED;
- complete at least an associate degree in a related field;
- have related work experience;
- have strong math skills;
- have a good eye for detail; and
- have good communication skills.

To work as a remote sensing scientist, you must:

- have a high school diploma or GED;
- complete at least a bachelor's degree in a related field;
- have strong math skills;
- have a good eye for detail; and
- have good communication skills.

EDUCATION AFTER HIGH SCHOOL

Almost all remote sensing scientists and technologists have a bachelor's degree in geography, civil engineering, environmental engineering, planning, surveying and mapping, or a related physical science. Computer science courses are a good addition to a student's preparation for this job. In addition, more colleges and universities are offering certificates in remote sensing, GIS, photogrammetry, or a related field.

Technologists can study for this field by gaining an associate degree in geography or a related field and working their way into this occupation through experience. However, the standard education level is a bachelor's degree.

Scientists in this field typically have a master's degree in geography or a related field. You need a doctoral (Ph.D.) degree to teach remote sensing and geospatial information at a college. Many colleges and universities offer advanced degrees in geography.

WORK EXPERIENCE

Working as a research assistant for a geographer is good experience for this field. Look for this kind of work when you are a college student. Some students complete an internship while in school. This is important work experience for finding a job.

ON-THE-JOB TRAINING

Depending on your employer, you may receive training on your first job. The length of training varies by employer, but may last up to one year.

Related Educational Programs

- Construction Trades
- Engineering
- Engineering Technologies
- Geography
- Natural Resources and Conservation
- Public Health

Hiring Practices

Employers look for scientists who have earned at least a bachelor's degree in geography, civil engineering, or a related field. Technologists need to have a two-year degree to gain work.

Employers look for workers who know how to use computers and mapping software. Remote sensing scientists and technologists also need good written and oral communication skills.

Advancement Opportunities

Experienced scientists may advance to jobs that require higher levels of skill and competency. This includes jobs in research, administration, and environmental planning. You usually need several years of experience and at least a master's degree to advance.

Technologists usually begin performing more basic tasks and advance through experience. Those with aptitude and leadership ability may move into lead technologist or supervisory roles. They typically must gain at least a bachelor's degree to move into more advanced positions.

Additional Sources of Information

- Hawai'i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai'i Career Information Delivery System, www.careerkokua.org

Robotics Engineers

At a Glance

- Design and test robotic parts and systems
- Most have a master's degree
- Have excellent math, science, physics, and computing skills
- Sit for long periods of time
- Are creative
- Earn $82,920 per year (Hawai'i median)

Overview

Robotics engineers research, design, develop, and test robotic applications.

Robots and robotic systems come in many shapes and sizes. Honda's humanoid ASIMO robot can walk, bend, dance, lift, and even walk up and down stairs. Large robotics systems can assemble cars. Other robotic systems can analyze DNA in a medical laboratory. Some surgeries can even be performed remotely by a doctor using a robotic arm.

The field of robotics engineering is complex. As a result, robotics engineers perform a lot of research in their job. They research different ideas and designs and test them on robotic prototypes. They analyze different functions and make adjustments. Depending on the field they work in, engineers may study human physiology to mimic human movement. Or, they may study automotive systems to make a robotic vehicle. Robotics engineers must be very good at computer science, as much of their design and research is through computer programming. They must be able to program a robot, debug the program, and reprogram the robot or robotic tool to do something different.

Because this field is constantly changing, robotics engineers must study and read to keep up their knowledge and skills. This occupation has a bright future in the emerging green economy, especially in the manufacturing and research industries. Robotics engineers can help develop greener manufacturing processes.

Specific Work Activities

The following list of occupational tasks is specific to robotics engineers.

- Build, configure, and test robots.
- Design robotic systems such as automatic vehicle control, vehicles that run by themselves, and computer visions. Design systems such as advanced displays, advanced sensing, and robotic platforms.
- Design software to control robotic systems for applications such as military defense and manufacturing.
- Design automated robotic systems to increase production and precision in biomedical and manufacturing settings.
- Analyze and evaluate robotic systems or prototypes.
- Analyze and survey laboratory robotics.
- Conduct research into the design, operation, or performance of robotic parts and systems. These include rovers, multiple mobile robots, robots that can be reconfigured, and robots that can interact with humans.
- Conduct research on robotic technology to create new robotic systems or system capabilities.
- Debug robotics programs.
- Design tools to be used as part of the robot's "arm."

Common Work Activities

Robotics engineers perform the following list of tasks, but the tasks are common to many occupations.

- Use computers.
- Make decisions and solve problems.
- Get information needed to do the job.

- Provide information or drawings about devices, equipment, or structures.
- Analyze data or information.
- Process information.
- Think creatively.
- Communicate with supervisors, peers, or subordinates.
- Identify objects, actions, and events.
- Evaluate information against standards.
- Update and use job-related knowledge.
- Monitor events, materials, and surroundings.
- Estimate sizes, quantities, time, cost, or materials needed.
- Control machines and processes.
- Repair and maintain electronic equipment.
- Repair and maintain mechanical equipment.
- Inspect equipment, structures, or materials.
- Coordinate the work and activities of others.
- Develop and build teams.
- Provide advice and consultation to others.

Related Occupations

This occupation is part of the **Science, Technology, Engineering, and Mathematics** cluster of occupations.

Related occupations include:
- Bioengineers
- Electrical and Electronics Engineers
- Industrial Engineers
- Manufacturing Engineers
- Mechanical Engineers

Hawai'i Career Pathways:
- Industrial & Engineering Technology

Related O*NET Specialties:
- Robotics Engineers

Skills and Abilities

Robotics engineers need to:

COMMUNICATE

- Read and understand work-related materials.
- Express ideas clearly when speaking or writing.
- Listen to others, understand, and ask questions.

REASON AND PROBLEM SOLVE

- Notice when something is wrong or is likely to go wrong.
- Analyze ideas and use logic to determine their strengths and weaknesses.
- Combine several pieces of information and draw conclusions.
- Develop rules or follow guidelines for arranging items.
- Use reasoning to discover answers to problems.
- Identify problems and review information. Develop, review, and apply solutions.
- Judge the costs and benefits of a possible action.
- Think of new ideas or original and creative ways to solve problems.
- Determine how a system should work. Study how changes in conditions affect outcomes.
- Understand new information or materials by studying and working with them.
- Concentrate and not be distracted while performing a task.
- Identify ways to measure and improve system performance.
- Remember information such as words, numbers, pictures, and procedures.

USE MATH AND SCIENCE

- Use math and science skills to solve problems.
- Add, subtract, multiply, and divide quickly and correctly.

MANAGE ONESELF, PEOPLE, TIME, AND THINGS

- Check how well one is learning or doing something.
- Manage the time of self and others.
- Motivate, develop, and direct people as they work.

WORK WITH PEOPLE

- Be aware of others' reactions and change behavior in relation to them.
- Use several methods to learn or teach others new things.
- Persuade others to approach things differently.

WORK WITH THINGS

- Test and inspect products, services, or processes. Evaluate quality or performance.
- Watch gauges, dials, and output to make sure a machine is working properly.
- Determine the tools and equipment needed to do a job.
- Determine the causes of technical problems and find solutions for them.
- Maintain equipment on a routine basis. Determine when and what kind of maintenance is needed.
- Repair machines or systems.
- Design equipment and technology to meet user needs.
- Analyze needs and requirements when designing products.
- Write computer programs.
- Operate and control equipment.

PERCEIVE AND VISUALIZE

- Imagine how something will look if it is moved around or its parts are rearranged.
- Identify a pattern (a figure, object, word, or sound) that is hidden in distracting material.
- Quickly and accurately compare letters, numbers, objects, pictures, or patterns.

Working Conditions

In a typical work setting, robotics engineers:

INTERPERSONAL RELATIONSHIPS

- Are significantly responsible for work outcomes and the work done by others.
- Have a medium level of social interaction. They spend time working with other engineers and technologists, but also spend time alone analyzing data.
- Are somewhat responsible for the health and safety of others.
- Are occasionally placed in conflict situations.
- Communicate mostly by e-mail, telephone, or in-person discussions. They also write letters and memos, but less often.
- Often work as part of a project team.

PHYSICAL WORK CONDITIONS

- Regulary wear safety attire.
- Usually work indoors.
- Are sometimes exposed to loud or distracting sounds or noise levels.
- Are occasionally exposed to hazardous equipment.
- May share lab or office space with others.

WORK PERFORMANCE

- Must be extremely accurate when performing the job. Errors significantly alter how a robotic device works.
- Rarely consult a supervisor before making a decisions or setting tasks and goals.
- Meet strict weekly and monthly deadlines. This makes the work atmosphere somewhat competitive.
- Regularly make decisions that strongly impact coworkers and their company.
- Repeat the same mental and physical tasks.
- Sometimes must match the pace of work to the speed of equipment.

HOURS / TRAVEL

- Generally have a set schedule each week.
- Usually work 40 hours a week. However, overtime is common, especially when nearing project deadlines.

Physical Demands

Robotics engineers frequently:

- Use their hands to handle, control, or feel objects, tools, or controls.
- Sit for long periods of time.

It is important for robotics engineers to be able to:

- See details of objects whether they are nearby or far away.
- Use fingers to grasp, move, or assemble very small objects.
- Understand the speech of another person.
- Speak clearly so listeners can understand.
- Hold the arm and hand in one position or hold the hand steady while moving the arm.

- Make quick, precise adjustments to machine controls.
- See differences between colors, shades, and brightness.

It is not as important, but still necessary, for robotics engineers to be able to:

- Determine the distance between objects.
- Focus on one source of sound and ignore others.
- Hear sounds and recognize the difference between them.
- Use one or two hands to grasp, move, or assemble objects.
- Adjust body movements or equipment controls to keep pace with speed changes of moving objects.
- Move two or more limbs together (for example, two arms, two legs, or one leg and one arm) while remaining in place.
- React quickly using hands, fingers, or feet.
- Choose quickly and correctly among various movements when responding to different signals.
- Use stomach and lower back muscles to support the body for long periods without getting tired.
- Make fast, repeated movements of fingers, hands, and wrists.
- While looking forward, see objects or movements that are off to the side.
- See objects in very bright or glaring light.
- Bend, stretch, twist, or reach out.

Knowledge

Robotics engineers need knowledge in the following areas:

- Engineering and Technology: Knowledge of how to build machines, buildings, and other things. Also includes knowledge of how to use computers, machines, and tools to do work more usefully.
- Computers and Electronics: Knowledge of computer hardware and software.
- Design: Knowledge of making and using plans, blueprints, drawings, and models.
- Mechanical: Knowledge of designing, using, and repairing machines and tools.
- Mathematics: Knowledge of the rules and uses of numbers. Areas of knowledge include arithmetic, algebra, geometry, and statistics.
- Production and Processing: Knowledge of how products are made and supplied.
- Physics: Knowledge of the features and rules of matter and energy. Areas of knowledge include air, water, light, heat, weather, and other natural events.
- English Language: Knowledge of the meaning, spelling, and use of the English language.
- Administration and Management: Knowledge of managing the operations of a business, company, or group.
- Education and Training: Knowledge of teaching and the methods involved in learning and instruction.
- Telecommunications: Knowledge of the equipment that is used to send messages as electronic impulses. Examples include radio, television, telegraph, and cable.
- Public Safety and Security: Knowledge of protecting people, data, and property.
- Customer and Personal Service: Knowledge of providing special services to customers based on their needs.

Interests

Robotics engineers are people who tend to:

- Consider good working conditions important. They like jobs offering steady employment and good pay. They want employment that fits their individual work style. They may prefer doing a variety of tasks, working alone, or being busy all the time.
- Consider independence important. They like to make decisions and try out ideas on their own. They prefer jobs where they can plan their work with little supervision.
- Consider achievement important. They like to see the results of their work and to use their strongest abilities. They like to get a feeling of accomplishment from their work.
- Consider recognition important. They like to work in jobs which have opportunities for them to advance, be recognized for their work, and direct and instruct

others. They usually prefer jobs in which they are looked up to by others.
- Consider support from their employer important. They like to be treated fairly and have supervisors who will back them up. They prefer jobs where they are trained well.
- Have investigative interests. They like work activities that have to do with ideas and thinking. They like to search for facts and figure out solutions to problems mentally.
- Have realistic interests. They like work activities that include practical, hands-on problems and solutions. They like to work with plants, animals, and physical materials such as wood, tools, and machinery. They often prefer to work outside.
- Have conventional interests. They like work activities that follow set procedures, routines, and standards. They like to work with data and detail. They prefer working where there is a clear line of authority to follow.

OCCUPATIONAL INTEREST CODES

- IRC

Wages

Wages vary by employer and area of the country. The engineer's level of training, experience, and responsibility also affect wages.

Robotics engineers who work full time usually receive benefits. Typical benefits include sick leave, paid vacation, and health insurance. Some employers also provide a retirement plan.

Location	Pay Period	25%	Median	75%
Hawai'i	Hourly	$30.51	$39.86	$45.89
	Yearly	$63,460	$82,920	$95,450
Honolulu	Hourly	$33.58	$40.55	$46.16
	Yearly	$69,850	$84,350	$96,010
United States	Hourly	$32.22	$43.06	$54.33
	Yearly	$67,030	$89,560	$113,010

Outlook

In Hawai'i and nationally, outlook information is not available specifically for robotics engineers. They are part of a larger group of "engineers, all other." Little change in employment is expected for workers in this group through 2018.

The table below provides information about the number of workers in this occupation in various regions. It also provides information about the expected growth rate and future job openings

EMPLOYMENT

Major employers:
- Aerospace product and parts manufacturers
- Engineering firms
- Federal government agencies
- Motor vehicle parts manufacturers
- Navigational and control equipment manufacturers

OUTLOOK

Much of the job growth for robotics engineers will be due to the growing green sector of the economy, especially in the manufacturing and research industries. Robotics engineers will be needed to help develop greener manufacturing processes. Opportunities will be best for engineers with strong mechanical, computing, and communication skills.

Job openings will occur each year as workers leave this occupation or retire.

	Employment		Employment Change	
	2008	2018	Number	Percent
National	183,200	195,400	12,200	6.7
State	730	730	0	0.0

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/

CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later. If you attend a private school, check with your school counselor for graduation requirements. Robotics engineers use math and science frequently. Try to take math classes through Trigonometry and science classes through Physics.

You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Blueprint Reading
- Computer Applications
- Computer Science
- Electronics
- Introduction to Mechanics

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and groups that may be available in your high school or community can be found at http://www.careerkokua.org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Licensing / Certification / Designation / Registration

In Hawai'i, engineers (except those employed by the federal government) whose work involves the safety or health of the public must be licensed by the Hawaii board of professional engineers, architects, surveyors, and landscape architects. In Hawaii, licenses are offered in seven disciplines of engineering which include agriculture, chemical, civil, electrical, industrial, mechanical, and structural. Licensure requires meeting educational and experience requirements, passing an exam, and paying fees.

Preparation

To work as a robotics engineer, you must:

- have a high school diploma or GED;
- have a bachelor's degree in engineering;
- have a graduate degree in robotics or a related field;
- be curious and detail-oriented;
- have strong analytical, math, and computer science skills; and
- be creative.

EDUCATION AFTER HIGH SCHOOL

Students begin preparing for this field by earning a bachelor's degree in engineering. There are very few robotics engineering bachelor's programs. However, the field of robotics is growing and preparation can also be gained through computer science, electronic engineering, and physics degree programs. Many four-year colleges and universities offer these programs of study. You may need between four and five years to complete this program.

Most workers in this occupation have some kind of advanced degree. Master's and Ph.D. programs in

engineering, artificial intelligence, and computer science are all good preparation for this field. With advanced degrees, robotics engineers can work in labs as lead engineers on projects. They can also teach at universities.

WORK EXPERIENCE

Consider participating in an internship with an engineering firm while you are in college. An internship offers you a chance to apply what you have learned in the classroom to a work situation. It also allows you to build skills and make contacts with people in the field.

ON-THE-JOB TRAINING

Because this job is very specialized and involves several disciplines, on-the-job training may vary by employer and project.

Related Educational Programs

- Computer and Information Sciences
- Electrical/Electronics Technologies
- Engineering
- Engineering Technologies
- Physics

Hiring Practices

Most employers require that robotics engineers have at least a bachelor's degree in engineering. Due to this occupation's complexity, many employers require a master's degree or even a doctorate. Employers also look for people with strong communication, computer, and mechanical skills. Certification or licensing may also be required.

Advancement Opportunities

Because the field of robotics is so complex, most robotics engineers have advanced degrees. This often means that they begin work on very difficult and complicated projects upon hiring. They may start out as a team member and by displaying their technical and problem-solving skills, they can advance to a leadership position. Some robotics engineers with business skills may create their own robotics companies and laboratories.

Additional Sources of Information

- Hawai'i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai'i Career Information Delivery System, www.careerkokua.org

Solar Panel Installers

Overview

Solar panel installers place solar panels in sunny places to gather the sun's power.

Solar panel installers help capture the sun's energy. Solar panel installers are also called solar photovoltaic installers, solar photovoltaic technicians, or solar installer-roofers. They install solar modules on the ground, on poles, on roofs, and on the sides of buildings. These solar modules are made from solar cells. The cells convert sunlight into electricity.

The most common type of solar module is the 3' × 5' flat solar panel. It is usually mounted on top of a roof. Before adding the panels to a roof, installers make sure that there is enough room and that the roof can hold the extra weight. If the roof isn't strong enough, installers reinforce it. Once the roof is ready, installers bolt structural framing, or racking, to the roof. They attach the solar panels to the frame and connect them with wires.

However, solar modules aren't limited to just the 3' × 5' panel. Flexible panels, roof tiles, and shingles are also common. Some building materials, such as siding or windows, are also made out of solar cells.

Installers run the wires down to a basement, garage, or outside box where the wires are hooked to an inverter. This device turns the energy captured by the solar cells into electricity that can be used by homes and businesses. Some systems include a battery backup that stores power for later use. Inverters must be wired to buildings by licensed electricians. Because of this requirement, many installers are licensed electricians. The last step is to activate the system and check that it is working correctly.

Lead installers might be responsible for getting work permits and inspections. They may work with utility companies to connect the systems to the main electrical grid. Some installers also repair solar modules that are already in use.

Most residential installations take about three days to complete. Large commercial installations can take several months. As a result, work schedules of solar panel installers can be similar to those of construction workers. They may work long hours on some days followed by periods of no employment.

A solar installer's work depends on the sun in more ways than one. An installer's day often starts early to avoid the worst of the heat. If it's raining, the work can't always be completed. Wet weather can make installation dangerous. Workers must be comfortable working at heights. Most commercial installations take place on flat roofs. Many residential installations take place on roofs with steep slopes and on loose or fragile materials, such as clay shingles. Installers often wear safety harnesses when working on these types of roofs.

Solar panel installers need mechanical skills. They must be able to use power tools and hand tools to construct equipment. Knowledge of electrical circuits and basic math are helpful. Attention to detail and problem-solving skills are important. They must be able to precisely follow diagrams and instructions. Heavy lifting is also required at times. Solar panels typically weigh between 30 and 40 pounds. Batteries can weigh even more.

As the use of solar power expands, the job tasks of solar panel installers are evolving. Some workers primarily install the panels. Others, especially those at small companies, do everything from sales to planning to wiring. Experienced installers may become lead installers, system designers, or sales representatives.

Related Occupations

This occupation is part of the **Architecture and Construction** cluster of occupations.

Related occupations include:
- Carpenters
- Electrician Helpers
- Electricians
- Line Installers and Repairers
- Weatherization Installers and Technicians

Wages

Entry-level solar panel installers are estimated to make between $12 and $15 an hour. Crew leaders are estimated to make between $20 and $25 an hour. Wages vary by location.

Workers who have an electrician's license typically earn more.

Outlook

Analysts expect that the solar-power industry will continue to grow rapidly. This is due to the trend in government incentives and increased consumer interest.

About 7,000 solar panel installers are employed in the U.S.

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later.

If you attend a private school, check with your school counselor for graduation requirements. Electronics engineering technologists need a strong background in math and science. Try to take math classes through Trigonometry and science classes through Physics.

You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Algebra
- Computer Science
- Electricity
- Equipment Maintenance and Repair
- Introduction to Mechanics
- Physical Science

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and groups that may be available in your high school or community can be found at http://www.careerkokua.org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Preparation

To work as a solar panel installer, you must:

- have a high school diploma or GED; and
- have work experience in a related occupation or have a combination of education and experience.

EDUCATION AFTER HIGH SCHOOL

A college degree is not required to become a solar panel installer. However, many installers have an associate degree in an electrical or solar field, or a certificate from a training program.

A small number of colleges and universities offer training or continuing education programs in solar energy. A list of training programs within the United States is available at: http://www1.eere.energy.gov/education/educational_professional.html.

Be careful when enrolling in solar installation programs. This is an emerging industry, and there are no standard training requirements. As a result, the quality of information provided by programs varies widely. You should investigate the schools you are interested in.

WORK EXPERIENCE

It is helpful to have mechanical or electrical work experience. People with construction backgrounds are well suited for the work. Roofing experience is valuable.

ON-THE-JOB TRAINING

If you have related work experience, you can become a solar panel installer through on-the-job training. The length of this training can vary. New workers often learn on the job, although training in solar installation or solar power is helpful.

Licensing / Certification / Designation / Registration

Typically, workers who install, test, and maintain electrical systems are required to have an electrician's license.

Hiring Practices

Some employers prefer to hire applicants who have associate degrees in an electrical or related field.

Voluntary certification is available and sometimes required by employers.

Additional Sources of Information

- Hawai'i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai'i Career Information Delivery System, www.careerkokua.org

Supply Chain Managers

At a Glance

- Manage the manufacturing process from beginning to end
- Usually have a bachelor's degree
- Seek ways to improve efficiency in the manufacturing world
- Work with supervisors, line workers, engineers, and managers
- Sit for long periods of time.
- Earn $74,840 per year (Hawai'i median)

Overview

Supply chain managers coordinate and plan all the steps necessary to make and sell a product, from beginning to end.

Imagine what it would be like to plan activities or processes for an entire company. This is called logistics, and makes up the majority of what a supply chain manager does. These workers are involved in nearly every aspect of a business, including planning, purchasing, transportation, storage, sales, and customer service.

Supply chain managers are excellent planners, analyzers, and communicators. They must be creative and flexible. For example, if they work for a clothing manufacturer, they have to be able to change suppliers for fabrics without interrupting manufacturing, distribution, and sales. They have to analyze inventory, storage, and transportation needs to make sure they have enough stock on hand. Supply chain managers must also be able to handle new product launches, which means they have to design, test, and adjust supply chains until they have everything running smoothly.

Good supply chain managers are continually examining the flow of business processes to make sure they are working efficiently. They talk with various workers, from drivers to purchasers to budget analysts, to see what their needs are and how to improve the operation. They also must forecast future trends for their company to anticipate changes.

The growing green economy will depend more and more on supply chain managers to help businesses use less energy as they manufacture products. They will also help manufacturers develop green products and technologies. They will also work in transportation, to help reduce the environmental impact of trucking and shipping products and supplies.

Specific Work Activities

The following list of occupational tasks is specific to supply chain managers.

- Design and put in place supply chains that help businesses with changing market conditions, new opportunities, or cost reduction.
- Coordinate supply chain management sales, marketing, finance, production, and quality assurance.
- Manage activities related to purchasing, material requirements, inventory control, warehousing, or receiving.
- Help coordinate engineering changes, product line extensions, or new product launches. Ensure orderly and timely transitions in material and production flow.
- Analyze information about supplier performance and procurement program success.
- Analyze inventory to see how inventory is used, reduce waste, or optimize customer service.
- Talk with supply chain planners to forecast demand or create supply plans that ensure availability of materials and products.
- Define performance standards for measurement, comparison, or evaluation of supply chain factors such as product cost and quality.
- Design and implement warehousing strategies for production materials or finished products.

- Develop and implement procedures or systems to evaluate and select suppliers.

Common Work Activities

Supply chain managers perform the following list of tasks, but the tasks are common to many occupations.

- Get information needed to do the job.
- Make decisions and solve problems.
- Use computers.
- Communicate with supervisors, peers, or subordinates.
- Develop and build teams.
- Organize, plan, and prioritize work.
- Analyze data or information.
- Establish and maintain relationships.
- Guide, direct, and motivate subordinates.
- Process information.
- Develop goals and strategies.
- Coordinate the work and activities of others.
- Coach others.
- Communicate with people from outside the organization.
- Resolve conflicts and negotiate with others.
- Recruit, interview, and hire others.
- Monitor and control resources.
- Update and use job-related knowledge.
- Identify objects, actions, and events.
- Provide advice and consultation to others.

Related Occupations

This occupation is part of the **Business, Management and Administration** cluster of occupations.

Related occupations include:
- Administrative Services Managers
- Budget Analysts
- General and Operations Managers
- Management Analysts
- Purchasing Managers
- Storage and Transportation Managers

Hawai'i Career Pathways:
- Business, Management & Technology

Related O*NET Specialties:
- Supply Chain Managers

Skills and Abilities

Supply chain managers need to:

COMMUNICATE

- Listen to others, understand, and ask questions.
- Read and understand work-related materials.
- Express ideas clearly when speaking or writing.

REASON AND PROBLEM SOLVE

- Notice when something is wrong or is likely to go wrong.
- Use reasoning to discover answers to problems.
- Analyze ideas and use logic to determine their strengths and weaknesses.
- Combine several pieces of information and draw conclusions.
- Judge the costs and benefits of a possible action.
- Determine how a system should work. Study how changes in conditions affect outcomes.
- Identify ways to measure and improve system performance.
- Develop rules or follow guidelines for arranging items.
- Make sense of information by studying it.
- Think of new ideas or original and creative ways to solve problems.
- Concentrate and not be distracted while performing a task.

USE MATH AND SCIENCE

- Use math skills to solve problems.
- Add, subtract, multiply, and divide quickly and correctly.

MANAGE ONESELF, PEOPLE, TIME, AND THINGS

- Check how well one is learning or doing something.
- Manage the time of self and others.
- Obtain needed equipment, facilities, and materials and oversee their use.
- Motivate, develop, and direct people as they work.

- Go back and forth between two or more activities or sources of information without becoming confused.

WORK WITH PEOPLE

- Be aware of others' reactions and change behavior in relation to them.
- Persuade others to approach things differently.
- Solve problems by bringing others together to discuss differences.
- Teach others how to do something.
- Look for ways to help people.

PERCEIVE AND VISUALIZE

- Identify a pattern (a figure, object, word, or sound) that is hidden in distracting material.

Working Conditions

In a typical work setting, supply chain managers:

INTERPERSONAL RELATIONSHIPS

- Have a medium to high level of social interaction with others.
- Communicate mostly by telephone, e-mail, and in-person conversations. They also write letters and memos, but less frequently.
- Are responsible for work outcomes and the work done by others.
- Are sometimes placed in conflict situations in which others may be rude or angry.
- Are somewhat responsible for the health and safety of others.

PHYSICAL WORK CONDITIONS

- Always work indoors.
- May share office space with others.

WORK PERFORMANCE

- Must be exact and accurate when performing the job. Errors can cost the company time and money.
- Rarely consult a supervisor before making a decisions or setting tasks and goals.
- Meet strict weekly and monthly deadlines. This makes the work atmosphere somewhat competitive.
- Regularly make decisions that greatly impact coworkers and their company.
- Sometimes repeat the same physical and mental tasks.

HOURS / TRAVEL

- Generally have a set schedule each week.
- Usually work 40 hours a week. However, overtime is common during project deadlines.

Physical Demands

Supply chain managers frequently:

- Sit for long periods of time.

It is important for supply chain managers to be able to:

- See details of objects that are less than a few feet away.
- Speak clearly so listeners can understand.
- Understand the speech of another person.

It is not as important, but still necessary, for supply chain managers to be able to:

- See details of objects that are more than a few feet away.
- See differences between colors, shades, and brightness.
- Use fingers to grasp, move, or assemble very small objects.
- Focus on one source of sound and ignore others.
- Hear sounds and recognize the difference between them.

Knowledge

Supply chain managers need knowledge in the following areas:

- Production and Processing: Knowledge of how products are made and supplied.
- Administration and Management: Knowledge of managing the operations of a business, company, or group.
- Transportation: Knowledge of ways to move people, goods, or materials. This may be by air, rail, sea, or road.

- English Language: Knowledge of the meaning, spelling, and use of the English language.
- Customer and Personal Service: Knowledge of providing special services to customers based on their needs.
- Mathematics: Knowledge of the rules and uses of numbers. Areas of knowledge include arithmetic, algebra, geometry, and statistics.
- Computers and Electronics: Knowledge of computer hardware and software.
- Economics and Accounting: Knowledge of producing, supplying, and using goods and services. Also includes knowledge of the methods for keeping business records.
- Personnel and Human Resources: Knowledge of the department that is in charge of the relationship between a company and its employees. In particular, includes knowledge of the activities performed by the department.

Interests

Supply chain managers are people who tend to:

- Consider independence important. They like to make decisions and try out ideas on their own. They prefer jobs where they can plan their work with little supervision.
- Consider good working conditions important. They like jobs offering steady employment and good pay. They want employment that fits their individual work style. They may prefer doing a variety of tasks, working alone, or being busy all the time.
- Consider support from their employer important. They like to be treated fairly and have supervisors who will back them up. They prefer jobs where they are trained well.
- Consider achievement important. They like to see the results of their work and to use their strongest abilities. They like to get a feeling of accomplishment from their work.
- Consider recognition important. They like to work in jobs which have opportunities for them to advance, be recognized for their work, and direct and instruct others. They usually prefer jobs in which they are looked up to by others.
- Have enterprising interests. They like work activities that involve starting up and carrying out projects, especially in business. They like to lead and persuade others, make decisions, and take risks for profit.
- Have conventional interests. They like work activities that follow set procedures, routines, and standards. They like to work with data and detail. They prefer working where there is a clear line of authority to follow.

OCCUPATIONAL INTEREST CODES

- EC

Wages

Wages for supply chain managers vary depending on their responsibilities and level of education. Their company size and area of the country can also affe affect wages.

Full-time managers usually receive benefits such as sick leave, paid vacation, and health insurance.

Location	Pay Period	25%	Median	75%
Hawai‘i	Hourly	$24.83	$35.98	$50.33
	Yearly	$51,640	$74,840	$104,690
Honolulu	Hourly	$25.42	$36.89	$49.99
	Yearly	$52,870	$76,730	$103,980
United States	Hourly	$31.78	$44.52	$59.22
	Yearly	$66,110	$92,600	$123,190

Outlook

In Hawai‘i, outlook information is not specifically available for supply chain managers. However, they are included in a larger group of “managers, all other.” Slower than average employment growth is expected for workers in this group through 2018.

Nationally, employment of workers in this group is expected to grow as fast as average through 2018.

The table below provides information about the number of workers in this occupation in various regions. It also provides information about the expected growth rate and future job openings.

EMPLOYMENT

Major employers:
- Business management companies
- State and local government agencies

OUTLOOK

Much of the job growth for supply chain managers will be due to the growing green sector of the economy. Supply chain managers will be needed to help businesses use less energy as they manufacture products. They will be needed to help manufacturers develop green products and technologies. They will also be needed in transportation, to help reduce the environmental impact of trucking and shipping products and supplies.

Because this is a large occupation, many openings will occur each year as managers transfer to other positions, start their own businesses, or retire. However, many who leave their jobs transfer to other management positions. This tends to limit the number of job openings for new entrants.

	Employment		Employment Change	
	2008	2018	Number	Percent
National	898,200	964,000	65,800	7.3
State	3,830	3,990	160	4.2

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later. If you attend a private school, check with your school counselor for graduation requirements.

You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Algebra
- Computer Applications
- Economics
- Introduction to Business
- Keyboarding

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and groups that may be available in your high school or community can be found at http://www.careerkokua.org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Preparation

To work as a supply chain manager, you must:

- have a high school diploma or GED;
- have at least a bachelor's degree;
- be curious and detail-oriented;
- have strong analytical skills;
- have good computer skills; and
- have good communication skills.

EDUCATION AFTER HIGH SCHOOL

Most supply chain managers have at least a bachelor's degree. Several fields of study provide good preparation for this occupation. These include manufacturing engineering, business, economics, math, and statistics. Common areas of graduate study are operations research, logistics, business administration, computer and information science, and industrial engineering.

WORK EXPERIENCE

Consider participating in an internship while in college. An internship offers you a chance to apply what you have learned in the classroom to a work situation. It also allows you to build skills and make contacts with people in the field.

ON-THE-JOB TRAINING

New graduates work under the guidance of experienced supply chain managers. In large companies, you may also receive formal classroom training. You work on more difficult tasks and get more independence in your work as you gain knowledge and experience. The length of training varies by employer. In general, you receive up to one year of additional training.

Related Educational Programs

- Business Management and Administration
- Computer and Information Sciences
- Economics
- Engineering

Hiring Practices

Most employers require that supply chain managers have at least a bachelor's degree in manufacturing engineering, business administration, or a related field. Some employers prefer people who have a master's degree in engineering management or business administration. Employers also look for people with strong communication skills and experience working in a manufacturing setting.

Advancement Opportunities

Experienced managers may advance by moving to larger departments where they manage larger runs or more complicated products. This would also entail working with and supervising additional employees.

Supply chain managers can advance into higher positions or earn higher pay through certification and continuing education.

Additional Sources of Information

- Hawai'i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai'i Career Information Delivery System, www.careerkokua.org

Validation Engineers

At a Glance

- Inspect, test, and adjust equipment to make sure it works precisely and accurately
- Have a bachelor's degree in engineering
- Work with their hands
- Have good math and spatial skills
- Are good at solving problems
- Earn $82,920 per year (Hawai'i median)

Overview

Validation engineers design, plan, and test equipment and procedures. They make sure equipment works precisely so that manufacturers can make high quality products.

Validation engineers work with sophisticated equipment, such as medical laboratory machines, and in other fields where precision is very important. They need to be very detail-oriented and have good math, science, and computer science skills. Their work goes beyond testing to see if a machine or process works. They need to make sure processes and machines work to precise standards. They need to understand everything about a process or a particular machine. Validation engineers also must be able to make tiny changes and adjustments to whatever it is they are testing.

Validation engineers also must be good with people. Typically they train others how to use and make minor adjustments to equipment. They often troubleshoot equipment as well. In some cases, validation engineers are in charge of selecting and purchasing equipment.

Validation engineers often work in biotechnology and medical fields. The green sector of the economy also requires these specialists to make manufacturing more efficient and to fine tune equipment. They can also help design and test new green technology. As a result, there will likely be increased demand in the green sector of the economy for validation engineers in the future.

Specific Work Activities

The following list of occupational tasks is specific to validation engineers:

- Analyze test data to determine whether systems or processes have met set criteria. Use data to identify causes of production problems.
- Prepare validation and performance protocols for new or modified manufacturing processes, systems, or equipment.
- Coordinate validation testing with affected departments and personnel.
- Study product characteristics or customer requirements. Confer with management to determine validation objectives and standards.
- Create, enter data into, or maintain databases for tracking validation activities, test results, or validated systems.
- Prepare, maintain, or review documentation such as engineering change notices, schematics, and protocols.
- Resolve problems by modifying testing methods or revising test objectives and standards.
- Prepare detailed reports based on results of validation and qualification tests or reviews of procedures and protocols.
- Identify differences from established product or process standards and provide recommendations for resolving deviations.
- Direct validation activities such as creating protocols or testing.

Common Work Activities

Validation engineers perform the following list of tasks, but the tasks are common to many occupations:

- Evaluate information against standards.
- Get information needed to do the job.
- Communicate with supervisors, peers, or subordinates.
- Analyze data or information.
- Identify objects, actions, and events.
- Monitor events, materials, and surroundings.
- Process information.
- Use computers.
- Make decisions and solve problems.
- Document and record information.
- Explain the meaning of information to others.
- Organize, plan, and prioritize work.
- Update and use job-related knowledge.
- Inspect equipment, structures, or materials.
- Judge the value of objects, services, or people.
- Establish and maintain relationships.
- Develop and build teams.
- Develop goals and strategies.
- Communicate with people from outside the organization.
- Provide advice and consultation to others.

Related Occupations

This occupation is part of the **Science, Technology, Engineering, and Mathematics** cluster of occupations.

Related occupations include:
- Bioengineers
- Electrical and Electronics Engineers
- Industrial Engineers
- Manufacturing Engineers
- Mechanical Engineers

Hawai'i Career Pathways:
- Industrial & Engineering Technology

Related O*NET Specialties:
- Validation Engineers

Skills and Abilities

Validation engineers need to:

COMMUNICATE

- Understand spoken or written information.
- Express ideas clearly when speaking or writing.

REASON AND PROBLEM SOLVE

- Use reasoning to discover answers to problems.
- Combine several pieces of information and draw conclusions.
- Notice when something is wrong or is likely to go wrong.
- Develop rules or follow guidelines when arranging items in a certain order.
- Concentrate and not be distracted while performing a task.
- Think of new ideas or original and creative ways to solve problems.

USE MATH AND SCIENCE

- Choose a mathematical method or formula to solve problems.

MANAGE ONESELF, PEOPLE, TIME, AND THINGS

- Go back and forth between two or more activities or sources of information without becoming confused.

PERCEIVE AND VISUALIZE

- Quickly and accurately compare letters, numbers, objects, pictures, or patterns.
- Identify a pattern (a figure, object, word, or sound) that is hidden in distracting material.
- Imagine how something will look if it is moved around or its parts are rearranged.

Working Conditions

In a typical work setting, validation engineers:

INTERPERSONAL RELATIONSHIPS

- Have a medium level of social interaction. They work with other engineers and workers, but also spend time analyzing test results and making changes to machines.
- Communicate via e-mail, telephone, or in-person discussions. They also write letters and memos, but less frequently.

- Are occasionally placed in conflict situations in which others may become upset or angry.
- Are somewhat responsible for the health and safety of coworkers.
- Are somewhat responsible for work outcomes and the work done by others.
- Usually work as part of a team.

PHYSICAL WORK CONDITIONS

- Are occasionally exposed to loud sounds and distracting noise levels.
- Sometimes wear protective or safety gear.
- Almost always work indoors.
- Sometimes work near others, usually within a few feet.
- Repeat the same physical and mental tasks.

WORK PERFORMANCE

- Must be very exact and accurate when testing and adjusting equipment.
- Usually do not consult a supervisor before making a decisions or setting tasks and goals.
- Meet strict daily and weekly deadlines. This makes the work atmosphere somewhat competitive.
- Often make decisions that strongly impact coworkers and their company.
- Repeat the same physical and mental tasks.

HOURS / TRAVEL

- Usually work a standard work week, but overtime may be common if a deadline is approaching or if equipment is malfunctioning.

Physical Demands

Validation engineers frequently:

- Sit for long periods of time.

It is important for validation engineers to be able to:

- See details of objects that are less than a few feet away.
- Speak clearly so listeners can understand.
- Understand the speech of another person.

It is not as important, but still necessary, for validation engineers to be able to:

- See differences between colors, shades, and brightness.
- See details of objects that are more than a few feet away.
- Use fingers to grasp, move, or assemble very small objects.
- Hear sounds and recognize the difference between them.
- Focus on one source of sound and ignore others.
- Make quick, precise adjustments to machine controls.
- Determine the distance between objects.
- Hold the arm and hand in one position or hold the hand steady while moving the arm.

Knowledge

Validation engineers need knowledge in the following areas:

- Engineering and Technology: Knowledge of how to build machines, buildings, and other things. Also includes knowledge of how to use computers, machines, and tools to do work more usefully.
- Production and Processing: Knowledge of how products are made and supplied.
- Mathematics: Knowledge of the rules and uses of numbers. Areas of knowledge include arithmetic, algebra, geometry, and statistics.
- English Language: Knowledge of the meaning, spelling, and use of the English language.
- Computers and Electronics: Knowledge of computer hardware and software.
- Design: Knowledge of making and using plans, blueprints, drawings, and models.
- Mechanical: Knowledge of designing, using, and repairing machines and tools.
- Customer and Personal Service: Knowledge of providing special services to customers based on their needs.
- Administration and Management: Knowledge of managing the operations of a business, company, or group.

- Clerical: Knowledge of general office work such as filing and recording information.

Interests

Validation engineers are people who tend to:

- Consider good working conditions important. They like jobs offering steady employment and good pay. They want employment that fits their individual work style. They may prefer doing a variety of tasks, working alone, or being busy all the time.
- Consider achievement important. They like to see the results of their work and to use their strongest abilities. They like to get a feeling of accomplishment from their work.
- Consider independence important. They like to make decisions and try out ideas on their own. They prefer jobs where they can plan their work with little supervision.
- Consider recognition important. They like to work in jobs which have opportunities for them to advance, be recognized for their work, and direct and instruct others. They usually prefer jobs in which they are looked up to by others.
- Consider support from their employer important. They like to be treated fairly and have supervisors who will back them up. They prefer jobs where they are trained well.
- Have investigative interests. They like work activities that have to do with ideas and thinking. They like to search for facts and figure out solutions to problems mentally.
- Have realistic interests. They like work activities that include practical, hands-on problems and solutions. They like to work with plants, animals, and physical materials such as wood, tools, and machinery. They often prefer to work outside.
- Have conventional interests. They like work activities that follow set procedures, routines, and standards. They like to work with data and detail. They prefer working where there is a clear line of authority to follow.

Occupational Interest Codes

- IRC

Wages

Wages vary by employer and area of the country. The engineer's level of training, experience, and responsibility also affect wages.

Validation engineers who work full time usually receive benefits. Typical benefits include sick leave, paid vacation, and health insurance. Some employers also provide a retirement plan.

Location	Pay Period	25%	Median	75%
Hawai'i	Hourly	$30.51	$39.86	$45.89
	Yearly	$63,460	$82,920	$95,450
Honolulu	Hourly	$33.58	$40.55	$46.16
	Yearly	$69,850	$84,350	$96,010
United States	Hourly	$32.22	$43.06	$54.33
	Yearly	$67,030	$89,560	$113,010

Outlook

In Hawai'i, outlook information is not available specifically for validation engineers. However, they are included in a larger group of "engineers, all other." Little change in employment is expected for workers in this group through 2018.

Nationally, employment of workers in this group is expected to grow slower than average through 2018.

The table below provides information about the number of workers in this occupation in various regions. It also provides information about the expected growth rate and future job openings.

Employment

Major employers:

- Engineering firms
- Federal, state, and local government agencies

OUTLOOK

Much of the job growth for validation engineers will be due to the growing green sector of the economy. Validation engineers will be needed to help make manufacturing more efficient. They will also be needed to help design and test new green technology. Opportunities will be best for engineers with strong mechanical, computing, and communication skills.

Job openings will occur each year as workers leave this occupation or retire.

	Employment		Employment Change	
	2008	2018	Number	Percent
National	183,200	195,400	12,200	6.7
State	730	730	0	0.0

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later. If you attend a private school, check with your school counselor for graduation requirements. Validation engineers use math and science frequently. Try to take math classes through Trigonometry and science classes through Physics.

You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Blueprint Reading
- Computer Applications
- Computer Science
- Electronics
- Introduction to Mechanics

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and groups that may be available in your high school or community can be found at http://www.careerkokua.org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Preparation

To work as a validation engineer, you must:

- have a high school diploma or GED;
- have a bachelor's degree in engineering;
- be curious and detail-oriented;
- have strong analytical skills; and
- be creative.

EDUCATION AFTER HIGH SCHOOL

Most students prepare for this field by earning a bachelor's degree in engineering. While there are some specific validation engineering programs, most students study for this occupation by getting a degree in

mechanical or industrial engineering. Many four-year colleges and universities offer these programs of study. You may need between four and five years to complete this program.

Some two-year colleges have agreements with the engineering departments at four-year schools. These agreements allow you to take your first two years of courses at the two-year college. Then you move to the university for the last two years. Some liberal arts schools have similar programs to prepare you for engineering schools. Some jobs require a master's or doctoral degree (Ph.D.). For instance, if you are interested in teaching validation engineering at a college you need a Ph.D. Also, many student engineers go to graduate school to specialize in an area of validation engineering

WORK EXPERIENCE

Consider participating in an internship with an engineering firm while you are in college. An internship offers you a chance to apply what you have learned in the classroom to a work situation. It also allows you to build skills and make contacts with people in the field.

ON-THE-JOB TRAINING

In general, validation engineers receive one to six months of on-the-job training. New graduates work under the guidance of experienced engineers. In large companies, you may also receive formal classroom training. As you gain knowledge and experience you have greater independence and work on more difficult tasks.

Related Educational Programs

- Engineering
- Engineering Technologies

Licensing / Certification / Designation / Registration

In Hawai'i, engineers (except those employed by the federal governemt) whose work involves the safety or health of the public must be licensed by the Hawai'i board of professional engineers, architects, surveyors, and landscape architects. In Hawaii, licenses are offered in seven disciplines of engineering which include agriculture, chemical, civil, electrical, industrial, mechanical, and structural. Licensure requires meeting educational and experience requirements, passing an exam, and paying fees.

Hiring Practices

Most employers require that validation engineers have at least a bachelor's degree in engineering. Some employers prefer people who have experience in quality control. Employers also look for people with strong communication and mechanical skills. Certification or licensing may also be required.

Advancement Opportunities

Beginning validation engineers start by performing basic tests and calibrations. Advancing to more complex precision inspecting and validation usually takes experience and perhaps more training, often paid for by the employer.

Advancement for validation engineers often is in the form of higher pay. Experienced engineers may move to management or supervisory positions.

Additional Sources of Information

- Hawai'i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai'i Career Information Delivery System, www.careerkokua.org

Weatherization Installers and Technicians

Overview

Weatherization installers and technicians weatherize homes to make them more energy efficient. They repair windows and insulate ducts. They also perform heating, ventilating, and air-conditioning (HVAC) work.

Weatherization installers and technicians focus on making homes and buildings more energy efficient by installing or changing existing features of the structure. To do this, the first task is to inspect the home. This is more than a quick walk-through. The technician or installer thoroughly checks every door and window for drafts and leaks and checks the attic and crawl space for insulation (and any damage to it). Special tools are needed to determine airflow and where hot or cold air might be lost.

Once the inspection is complete, weatherization installers and technicians make recommendations to the client. They inform them on what should be replaced, installed, or changed. This involves explaining what each change might look like and what it will do, from updating to a new water heater to something simple such as installing a low-flow showerhead to save water. They also prepare cost estimates of these changes to help homeowners decide the best course of action.

Weatherization installers and technicians have to understand both electrical and heating systems. These workers must have good mechanical skills and be able to work with a variety of equipment. They use special tools not only for testing, but to install or fix new doors, windows, and insulation. They also work with traditional materials, such as wood and drywall, windows and caulk. In addition, they wrap pipes and ductwork to seal leaks or prevent energy loss.

Weatherization installers and techs maintain records of their work and all their billing. They also must clean and maintain their tools.

Related Occupations

This occupation is part of the **Architecture and Construction** cluster of occupations.

Related occupations include:
- Carpenters
- Construction Helpers
- Electricians
- Heating and Cooling Mechanics
- Solar Panel Installers

Hawai‘i Career Pathways:
- Industrial & Engineering Technology

Outlook

Analysts expect that the weatherization industry will continue to grow. This is due to the trend in government incentives. It is also due to increased consumer interest.

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later.If you attend a private school, check with your school counselor for graduation requirements.

You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP)

and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Algebra
- Computer Science
- Electricity
- Equipment Maintenance and Repair
- Introduction to Mechanics
- Physical Science

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking.

You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. Click here for examples of activities and groups that may be available in your high school or community.

Licensing / Certification / Designation / Registration

Typically, workers who install, test, and maintain electrical systems are required to have an electrician's license.

Licensing by the Hawai'i board of electricians and plumbers is required for most journey-level electricians in Hawai'i. Licensing requirements include:

- having at least five years but not less than 10,000 hours of electrical wiring work, primarily involved in residential and commercial wiring (for journey worker license);
- having at least five years but not less than 10,000 hours of industrial wiring (for journey worker industrial electricians);
- having at least five years of specialty wiring work—low voltage (for journey worker specialty electricians);
- having at least one year of electrical maintenance wiring work or two years of electrical trade schooling (for maintenance electricians);
- passing the exam.

Fees include: $40 for application, $120 for three-year license, and $105 for triennial compliance resolution fund. Applicants must also submit a registration form and exam fee to the testing contractor. Licenses must be renewed every three years. Licensed electricians (except maintenance electricians) must attend a course covering the updates to the national electrical code (nec) or pass an exam on current updates to the nec in order to renew their license. Fees and requirements are subject to change.

Preparation

To work as a weatherization installer and technician, you must:

- have a high school diploma or GED; and
- have work experience in a related occupation or have a combination of education and experience.

EDUCATION AFTER HIGH SCHOOL

A college degree is not required to become a weatherization installer or technician. However, many installers and technicians have an associate degree in a building trade-related field, or a certificate from a training program.

A small number of colleges and universities offer training or continuing education programs in weatherization installation or technology. These

programs offer specific courses in weatherization techniques as well as courses in workplace safety and basic building and construction skills.

Some employers prefer to hire applicants who have an associate degree in a building trade.

Voluntary certification is available. In fact, it is sometimes required by employers. Workers with certificates in this field tend to earn more than those who don't.

WORK EXPERIENCE

It is helpful to have construction, mechanical or electrical work experience. People with construction backgrounds are well suited for the work.

ON-THE-JOB TRAINING

If you have related work experience, you can become a weatherization installer or technician through on-the-job training. The length of this training can vary.

Related Educational Programs

- Apprenticeship
- Construction Trades

Additional Sources of Information

- Hawai'i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai'i Career Information Delivery System, www.careerkokua.org

Wind Energy Engineers

Overview

Wind energy engineers design wind farm collector systems. They prepare and develop wind farms for specific sites.

While wind as a source of power is not really very new, wind energy engineering is a new profession. To develop a wind farm, the engineer must bring together the right technology (wind turbines) in the right place (open spaces with lots of wind), good transportation, and a connection to the electrical grid.

When identifying sites for wind farms, the engineer calculates wind power density (WPD) to make sure the farm will be productive. There are many other considerations; it is not easy to find the perfect location that has high WPD but can also be easily reached by engineers, technicians, and other workers. Some wind farms are even located at sea.

Wind energy engineers use complex computer software to lay out wind farms and to test and operate turbines and other systems. They are responsible for developing and testing all the components that make up an energy farm, including gearboxes, generators, and converters. Engineers also oversee the construction phase when the turbines and substations are transported to the site and installed.

A big part of a wind energy engineer's job is to test turbines and systems before the farm is completely operational. They may test using mechanical and electronic equipment. They look for energy output as well as stress or fatigue on parts, troubleshoot problems, and recommend adjustments.

Related Occupations

This occupation is part of the **Science, Technology, Engineering, and Mathematics** cluster of occupations.

Related occupations include:
- Electrical and Electronics Engineers
- Energy Engineers
- Mechanical Engineers
- Renewable Energy Engineers
- Wind Energy Operations Managers

Hawai'i Career Pathways:
- Industrial & Engineering Technology

Wages

Wind energy engineers can expect a starting salary from $70,000 and upwards.

Outlook

Analysts expect that the wind-power industry will continue to grow rapidly. This is due to government incentives and increased consumer interest.

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later.

If you attend a private school, check with your school counselor for graduation requirements. Electronics engineering technologists need a strong background in math and science. Try to take math classes through

Trigonometry and science classes through Physics. You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Blueprint Reading
- Computer Applications
- Computer-Assisted Design (CAD
- Electronics
- Keyboarding
- Natural Resources Management
- Probability and Statistics

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and groups that may be available in your high school or community can be found at http://www.careerkokua.org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Preparation

To work as a wind farm engineer, you must:

- have a high school diploma or GED;
- have a bachelor's degree in mechanical engineering or a related field;
- be curious and detail-oriented;
- have strong analytical skills; and
- be creative.

EDUCATION AFTER HIGH SCHOOL

Most students prepare for this field by earning a bachelor's degree in mechanical engineering. Many four-year colleges and universities offer this program of study. You may need between four and five years to complete this program.

Some jobs require a master's or doctoral degree (Ph.D.). For instance, if you are interested in teaching mechanical engineering at a college you need a Ph.D. Also, many student engineers go to graduate school to specialize in one area of mechanical engineering.

In a typical four-year program, classes include math, basic science, introductory engineering, and social science. Courses may include mechanics and materials, turbines and engine engineering, and product engineering. You may also study design and manufacturing and mechanical vibration.

Some two-year colleges have agreements with the engineering departments at four-year schools. These agreements allow you to take your first two years of courses at the two-year college. Then you move to the university for the last two years. Some liberal arts schools have similar programs to prepare you for engineering schools.

WORK EXPERIENCE

You should consider participating in an internship with an engineering firm while you are in college. It offers you a chance to apply what you have learned in the classroom to a work situation. It also allows you to build skills and make contacts with people in the field.

ON-THE-JOB TRAINING

In general, wind energy engineers receive one to two years of on-the-job training. New graduates work under the guidance of experienced engineers. In large

companies, you may also receive formal classroom training. As you gain knowledge and experience you have greater independence and work on more difficult tasks.

Related Educational Programs

- Engineering

Licensing / Certification / Designation / Registration

In Hawai'i, engineers (except those employed by the federal government) whose work involves the safety or health of the public must be licensed by the Hawai'i board of professional engineers, architects, surveyors, and landscape architects. In Hawai'i, licenses are offered in seven disciplines of engineering which include agriculture, chemical, civil, electrical, industrial, mechanical, and structural. Licensure requires meeting educational and experience requirements, passing an exam, and paying fees.

Additional Sources of Information

- Hawai'i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai'i Career Information Delivery System, www.careerkokua.org

Wind Energy Operations Managers

Overview

Wind energy operations managers oversee wind farm operations. They manage employees, maintenance activities, financial activities, and planning.

While wind power and windmills have been around for centuries, wind energy farms are a new "crop" in the "green" economy. Engineers and project managers design and build wind energy farms. Once they are built, operations managers are needed to oversee the day-to-day work of wind energy farms, making sure they produce energy while running well.

One of the main tasks of a wind energy operations manager is to oversee the maintenance of the equipment used in a wind farm. For example, they determine if towers or transformers need cleaning or repair. Because wind energy farms are located in rural areas, or even in the ocean, managers make sure roadways and other transportation methods are maintained. This ensures that workers, engineers, and technicians can reach them easily. Operations managers often must order parts and equipment needed for maintenance and upgrades.

Operations managers often work with engineers and project managers as new farms become operational. They develop relationships with customers, site managers, land owners, and residents. They also prepare budgets. Operations managers work with local utility representatives and local government authorities. They must have excellent communication skills. They must also be organized and detail-oriented. Keeping records of conversations, contracts, and maintenance is very important.

A big part of running a wind energy farm is managing employees. Managers supervise employees and subcontractors. They make sure work is performed well and that all safety regulations are followed. They oversee budgets and costs, schedules, and timelines. Like any manager, they resolve any conflicts that may arise, whether it is over a budget item or a deadline. They may also recruit and hire employees and contractors. They often help train new employees so they can learn day-to-day tasks and how to perform the work safely and in compliance with regulations and codes.

Related Occupations

This occupation is part of the **Manufacturing** cluster of occupations.

Related occupations include:
- General and Operations Managers
- Power Plant Operators
- Wind Energy Engineers
- Wind Energy Project Managers

Hawai'i Career Pathways:
- Industrial & Engineering Technology

Wages

Wind energy operations managers with the appropriate experience and training can expect to earn from $65,000 to $100,000 annually.

Outlook

Analysts expect that the wind-power industry will continue to grow rapidly. This is due to government incentives and increased consumer interest.

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound

students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later.

If you attend a private school, check with your school counselor for graduation requirements. You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Algebra
- Computer Science
- Keyboarding
- Business
- Introduction to Mechanics
- Physical Science

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and groups that may be available in your high school or community can be found at http://www.careerkokua.org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Preparation

To work as a wind energy operations manager, you must:

- have a high school diploma or GED;
- have a bachelor's degree in engineering, business, or a related field;
- have several years of experience in the wind energy industry;
- be curious and detail-oriented;
- have strong analytical skills; and
- be creative.

Education after high school

There are a variety of ways to train for this occupation. Most students prepare for this field by earning a bachelor's degree in mechanical engineering or business. Because this job combines both technical and planning skills, taking courses outside your major to round out your training is important. This means that if you major in engineering, you should also consider a minor in business. Earning a bachelor's degree in engineering and then a master of business administration (MBA) is great training for this occupation.

Consider participating in an internship with a wind power engineering firm while you are in college. An internship offers you a chance to apply what you have learned in the classroom to a work situation. It also allows you to build skills and make contacts with people in the field.

Employers look for candidates with at least a bachelor's degree and several years of experience working in the wind energy field.

On-the-job training

Operations managers typically have several years experience in the wind energy field, so they do not receive much formal training once hired.

Related Educational Programs

- Business Management and Administration
- Engineering

Additional Sources of Information

- Hawai'i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai'i Career Information Delivery System, www.careerkokua.org

Wind Energy Project Managers

Overview

Wind energy project managers oversee all phases of developing and building wind energy farms.

Wind energy project managers oversee the day-to-day functioning of wind energy farms while they are being built. They also help engineers plan for new energy farms. However, they focus less on technical items about the turbines or wind sheer. Instead, they focus on how big the farm will be (scope), assigning tasks, determining schedules and costs, and setting goals and deadlines.

Project managers must have a solid knowledge of wind energy. They need to understand the needs of engineers and technicians. However, what project managers need most of all are organizational skills and an eye for details. Scientific knowledge is helpful, but an educational background in planning and administration is essential.

When constructing a wind energy farm, project managers look at potential sites. They analyze environmental studies and civil engineering surveys. This helps them determine the best place to build. They review bids from different contractors to see what companies offer the best services for the best price. Project managers coordinate all construction activities. They oversee the different contractors who work to transport and build the turbines and substations. They review contracts and budgets to make sure that costs are contained, work is being performed well and on time, and that laws and regulations are followed. They make sure proper permits are obtained and comply with inspections.

Project managers also conduct negotiations about tax agreements and purchasing contracts. Because wind energy farms are usually located on large amounts of land or in the sea, project managers may have to work with private owners as well as local and state governments to negotiate the use of land and air.

Related Occupations

This occupation is part of the **Architecture and Construction** cluster of occupations.

Related occupations include:
- Construction and Building Inspectors
- Construction Managers
- Project Managers
- Wind Energy Operations Managers

Hawai'i Career Pathways:
- Industrial & Engineering Technology

Wages

Wind energy project managers with the appropriate experience and training can expect to earn between $50,000 and $70,000 annually.

Outlook

Analysts expect that the wind power industry will continue to grow rapidly. This is due to government incentives and increased consumer interest.

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later.

If you attend a private school, check with your school counselor for graduation requirements. You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Blueprint Reading
- Computer Applications
- Computer-Assisted Design (CAD)
- Drafting
- Electronics
- Keyboarding
- Business

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and groups that may be available in your high school or community can be found at http://www.careerkokua.org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Preparation

To work as a wind energy project manager, you must:

- have a high school diploma or GED;
- have a bachelor's degree in engineering, business, or an earth science;
- be curious and detail-oriented;
- have strong analytical skills; and
- be creative.

Education after high school

Most students prepare for this field by earning a bachelor's degree in mechanical engineering, business, or earth sciences. Because this job combines both technical and planning skills, taking courses outside your major to round out your training is important. This means that if you major in engineering, you should also consider minoring in business.

Consider participating in an internship with a wind power engineering firm while you are in college. An internship offers you a chance to apply what you have learned in the classroom to a work situation. It also allows you to build skills and make contacts with people in the field.

On-the-job training

In general, new project managers receive on-the-job training. New graduates work under the guidance of experienced engineers and managers. In large companies, you may also receive formal classroom training. As you gain knowledge and experience you have greater independence and work on more difficult tasks.

Related Educational Programs

- Business Management and Administration
- Engineering

Additional Sources of Information

- Hawai'i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai'i Career Information Delivery System, www.careerkokua.org

Wind Turbine Technicians

Overview

Wind turbine technicians assemble, maintain, and repair wind turbines used in energy generation.

Wind farms have several wind turbines clustered together. Wind turbines capture wind energy and convert it to electricity for use by homeowners and businesses. Wind turbines are also called wind generators, wind power units, wind energy converters, or aero generators. While nature provides the wind, it's humans that install and maintain the turbines.

There are currently an estimated 25,000 wind turbines in use throughout the world. Growing demand for wind energy has created the need for skilled workers who can keep giant wind turbine machines running. These workers are called wind turbine technicians. Wind turbine technicians are also called wind farm technicians. They play a key role in ensuring the safety and service of wind turbine units. Technicians perform preventative maintenance. When there is a problem, they do mechanical and electrical troubleshooting and repairs.

Each turbine tower undergoes maintenance periodically. During this checkup, technicians check moving parts and repair and replace malfunctioning parts and equipment. Some tasks are simple, such as changing filters and analyzing oil. Others are more complex, such as maintaining electrical motors, hydraulics, transmissions, and drives. Maintaining the turbines also involves checking computers. There is a large computer inside the base of the support tower and the one at the top of the tower. Technicians climb a series of ladders to reach the top of the tower. Wind turbine towers reach heights of 200 feet or more and technicians must carry their equipment up with them. You must be in good shape and be comfortable working at heights to perform this job.

Once at the top, technicians inspect both the outside and inside of the turbine. Technicians inspect the inside of the turbine by entering the nacelle, which is the box that holds the gears, motor, and generator. Much of the regular maintenance that technicians perform requires them to squeeze down into the "hole" or bottom of the nacelle. They use rags and cleanser to clean up oil and grease that has dripped off of the equipment. Even though the parts used to operate the turbine are very large, they are also very delicate and could fail if not kept very clean. While in the nacelle, technicians also change fluid filters in the gearbox, which is the part that spins the generator. If there is a problem with the blades, technicians must climb out of the nacelle, over the blades, and into the cone. Technicians also inspect the outside of the turbine by climbing on top of it. They make sure all of the instruments are secure and the fiberglass top is in working order and not damaged. Teamwork is important for technicians since usually two or more work together and safety and a smooth-running work environment are critical.

There are currently an estimated 25,000 wind turbines in use throughout the world. Due to the rapidly growing number of wind farms, many technicians travel throughout the U.S to work at these farms. Some positions require international travel.

Related Occupations

This occupation is part of the **Science, Technology, Engineering, and Mathematics** cluster of occupations.

Related occupations include:
- Electric Motor Repairers
- Industrial Electronics Repairers
- Industrial Machinery Mechanics

Working Conditions

In a typical work setting, wind turbine technicians:

PHYSICAL WORK CONDITIONS

- Use computers.
- Work in tight spaces and noisy conditions.
- Work at heights of 200 feet or more.
- Often exposed to inclement weather, such as high winds and rain.

HOURS / TRAVEL

- Travel frequently. Some jobs require international travel.

Knowledge

Wind turbine technicians need knowledge in the following areas:

- Hydraulics
- Electricity
- Algebra
- Meteorology

Helpful High School Courses

In high school, take classes that prepare you for college. A college preparatory curriculum (see http://www.careerkokua.org/ce/occ/occ/modules/pdf/CollegePrep%20Curriculum.pdf for a listing of recommended high school courses for college-bound students) may be different from our state's graduation requirements. Go to http://graduation.k12.hi.us/pdfs/Class_of_2010,2011,2012_WEB.pdf for public school graduation requirements for students graduating in 2011 or 2012. Visit http://graduation.k12.hi.us/pdfs/Class_of_2013.pdf for public school graduation requirements for students graduating in 2013 or later.

If you attend a private school, check with your school counselor for graduation requirements. You should also consider taking some advanced courses in high school. This includes Advanced Placement (AP) and International Baccalaureate (IB) courses if they are available in your school. If you do well in these courses, you may receive college credit for them. Advanced courses can also strengthen your college application.

Helpful electives to take in high school that prepare you for this occupation include:

- Algebra
- Computer Science
- Electricity
- Equipment Maintenance and Repair
- Introduction to Mechanics
- Physical Science

The courses listed above are meant to help you create your high school plan. If you have not already done so, talk to a school counselor or parent about the courses you are considering taking. You should also check with a teacher or counselor to see if work-based learning opportunities are available in your school and community. These might include field trips, job shadowing, internships, and actual work experience. The goal of these activities is to help you connect your school experiences with real-life work.

Join some groups, try some hobbies, or volunteer with an organization that interests you. By participating in activities you can have fun, make new friends, and learn about yourself. Maybe one of them will help direct you to a future career. A list of examples of activities and groups that may be available in your high school or community can be found at http://www.careerkokua.org/ce/occ/occ/modules/pdf/Clubs%20and%20Groups.pdf.

Preparation

To work as a wind turbine technician, you must:

- have a high school diploma or GED; and
- have work experience in a related occupation or have a combination of education and experience.

EDUCATION AFTER HIGH SCHOOL

A college degree is not required to become a wind turbine technician. However, many technicians have an associate degree or a certificate from a training program. A background and understanding of mechanical and electrical principles are good preparation.

A small number of colleges and universities offer training or continuing education programs in wind energy. A list of training programs within the United States is available at: http://www.windpoweringamerica.gov/schools_training.asp

Be careful when enrolling in programs in this area. Because this is an emerging area of study, the industry does not yet have training requirements. As a result, the quality and depth of information provided by programs vary widely. You should investigate the schools you are interested in.

WORK EXPERIENCE

Wind farming is an emerging industry so there is currently no U.S. accepted standard for wind turbine technicians. Generally, those with work experience in a related occupation are able to find jobs as technicians. You should have a strong technical background. You may need training in safety requirements specific to wind turbine technology.

ON-THE-JOB TRAINING

Graduates of certificate programs generally need on-the-job training to become wind turbine technicians. The length of training varies by employer and your skills.

Additional Sources of Information

- Hawai'i Workforce Infonet, www.hiwi.org
- Career Kōkua, the Hawai'i Career Information Delivery System, www.careerkokua.org

hawai‘i green jobs initiative

Department of Labor and Industrial Relations