businesses, as well as satellite, microwave, and fiber networks that form the backbone of the civil and military communications infrastructure.

Power engineers deal with energy generation by a variety of methods, such as turbine, hydro, fuel cell, solar, geothermal, and wind. They also deal with electrical power distribution from source to consumer and within factories, offices, hospitals, and laboratories, and they design electric motors and batteries. In industry, power engineers work wherever electrical energy is used to manufacture or produce an end product. They are needed to design electrical distribution systems and instrumentation and control systems for the safe, effective, and efficient operation of the production facilities.

The **computer industry** serves many sectors, and electrical engineers play a major role. Electrical engineering has strong connections to computer engineering and at many universities, the computer engineering and electrical engineering programs co-exist within the same department.

The chief enabling technology at the heart of the electronic components booming computer industry is **semiconductor technology**, in particular the development and manufacture of integrated circuits. As integrated circuits companies search for faster and more powerful chips, they seek engineers to investigate new materials and improved packaging—engineers who can handle the challenge of competitive pressure and ever-shorter development time. Manufacturers of microprocessors and memory chips, for example, continuously improve existing products and introduce new ones to beat the competition and meet customers' expectations of ever-higher performance. Semiconductor products include not just digital ICs but also analog chips, mixed-signal (analog and digital) integrated circuits, and radio-frequency (RF) integrated circuits, as well as power devices.

Environmental Engineering Using the principles of biology and chemistry, environmental engineers develop solutions to environmental problems. They are involved in water and air pollution control, recycling, waste disposal, and public health issues. Environmental engineers conduct hazardous-waste management studies in which they evaluate the significance of the hazard, offer analysis on treatment and containment, and develop regulations to prevent mishaps. Environmental engineers are concerned with local and worldwide environmental issues. They study and attempt to minimize the effects of acid rain, global warming, automobile emissions, and ozone depletion. They also work to protect wildlife; many environmental engineers work as consultants, helping their clients to comply with regulations and to clean up hazardous sites.

Environmental engineers' job duties include collecting soil or groundwater samples and testing them for contamination; designing municipal sewage and industrial wastewater systems; analyzing scientific data; researching controversial projects; and performing quality control checks. Some environmental engineers work in legal or financial consulting regarding environmental processes or issues.

Industrial Engineering Industrial engineers determine the most effective ways to use the basic factors of production—people, machines, materials, information, and energy—to make a product or to provide a service. They are the bridge between management goals and operational performance. They are more interested in increasing productivity through the management of people, methods of business organization, and technology than are engineers in other specialties, who generally work more with products or processes. Although most industrial engineers work in manufacturing industries, some work in consulting services, health care, and communications.

To solve organizational, production, and related problems effectively, industrial engineers carefully study the product and its requirements, use mathematical methods such as operations research to meet those requirements, and design manufacturing and information systems. They develop management control systems to aid in financial planning and cost analysis and design production planning and control systems to coordinate activities and ensure product quality. They also design or improve systems for the physical distribution of goods and services. Industrial engineers determine which plant location has the best combination of raw materials availability, transportation facilities, and costs. Industrial engineers use computers for simulations and to control various activities and devices, such as assembly lines and robots. They also develop wage and salary administration systems and job evaluation programs. Many industrial engineers move into management positions because the work is closely related.

Manufacturing Engineering Manufacturing engineers are involved with the process of manufacturing from planning to packaging of the finished product. They work with tools such as robots, programmable and numerical controllers, and vision systems to fine-tune assembly, packaging, and shipping facilities. They examine flow and the process of manufacturing, looking for ways to streamline production, improve turnaround, and reduce costs. Often, a manufacturing engineer works with a prototype, usually created electronically with computers, to plan the final manufacturing process. In a globally competitive marketplace, the manufacturing engineer's job is to determine methods and systems to produce a product in an efficient, cost-effective way to provide a marketing edge for the final product.

Materials Engineering Materials engineering is a field of engineering that encompasses the spectrum of materials types and how to use them in manufacturing. Materials span the range: metals, ceramics, polymers (plastics), semiconductors, and combinations of materials called composites. We live in a world both dependent upon and limited by materials. Everything we see and use is made of materials: cars, airplanes, computers, refrigerators, microwave ovens, TVs, dishes, silverware, athletic equipment of all types, and even biomedical devices such as replacement joints and limbs. All of these require materials specifically tailored for their application. Specific properties are required that result from carefully selecting the materials and from controlling the manufacturing processes used to convert the basic materials into the final engineered product. Exciting new product developments frequently are possible only through new materials and/or processing.

New materials technologies developed through engineering and science will continue to make startling changes in our lives in the future, and people in materials science and engineering will continue to be key in these changes and advances. These engineers deal with the science and technology of producing materials that have properties and shapes suitable for practical use.

Activities of materials engineers range from primary materials production, including recycling, through the design and development of new materials, to the reliable and economical manufacturing of the final product. Such activities are common in industries such as aerospace, transportation, electronics, energy conversion, and biomedical systems. The future will bring ever-increasing challenges and opportunities for new materials and better processing. Materials are evolving faster today than at any time in history. New and improved materials are an "underpinning technology"—one which can stimulate innovation and product improvement. High-quality products result from improved processing and more emphasis will be placed on reclaiming and recycling. For these many reasons, most surveys name the materials field as one of the careers with excellent future opportunities.

Mechanical Engineering Mechanical engineering is one of the largest, broadest, and oldest engineering disciplines. Mechanical engineers use the principles of energy, materials, and mechanics to design and manufacture machines and devices of all types. They create the processes and systems that drive technology and industry.

The key characteristics of the profession are its breadth, flexibility, and individuality. Individual choices of engineers determine their career paths. Mechanics, energy and heat, mathematics, engineering sciences, design and manufacturing form the foundation of mechanical engineering. Mechanics includes fluids, ranging from still water to hypersonic gases flowing around a space vehicle; it involves the motion of anything from a particle to a machine or complex structure.

Mechanical engineers research, develop, design, manufacture, and test tools, engines, machines, and other mechanical devices. They work on power-producing machines such as electric generators, internal combustion engines, and steam and gas turbines, as well as power-using machines such as refrigeration and air-conditioning equipment, machine tools, material handling systems, elevators and escalators, industrial production equipment, and robots used in manufacturing. Mechanical engineers also design tools other engineers need for their work. Mechanical engineers work in production operations in manufacturing or agriculture, maintenance, or technical sales; many are administrators or managers.

Mining Engineering Mining and geological engineers, including mining safety engineers, find, extract, and prepare coal, metals, and minerals for use by manufacturing industries and utilities. They design open-pit and underground mines, supervise the construction of mine shafts and tunnels in underground operations, and devise methods for transporting minerals to processing plants. Mining engineers are responsible for the safe, economical, and environmentally sound operation of mines.

Some mining engineers work with geologists and metallurgical engineers to locate and appraise new ore deposits. Others develop new mining equipment or direct mineral-processing operations that separate minerals from the dirt, rock, and other materials with which they are mixed.

Mining engineers frequently specialize in the mining of one mineral or metal, such as coal or gold. With increased emphasis on protecting the environment, many mining engineers work to solve problems related to land reclamation and water and air pollution. Mining safety engineers use their knowledge of mine design and practices to ensure the safety of workers and to comply with state and federal safety regulations. They inspect walls and roof surfaces, monitor air quality, and examine mining equipment for compliance with safety practices.

Nuclear Engineering Nuclear engineers research and develop the processes, instruments, and systems for national laboratories, private industry, and universities that derive benefits from nuclear energy and radiation for society. They devise ways to use radioactive materials in manufacturing, agriculture, medicine, power generation, and many other ways.

Many nuclear engineers design, develop, monitor, and operate nuclear plants used to generate power. They may work on the nuclear fuel cycle—the production, handling, and use of nuclear fuel and the safe disposal of waste produced by the generation of nuclear energy. Others research the production of fusion energy. Some specialize in the development of power sources for spacecraft that use radioactive materials. Others develop and maintain the nuclear imaging technology used to diagnose and treat medical problems.

Petroleum Engineering Petroleum engineers search the world for reservoirs containing oil or natural gas. Once they discover these resources, petroleum engineers work with geologists and other specialists to understand the geologic formation and properties of the rock containing the reservoir, determine the drilling methods to use, and monitor drilling and production operations. They design equipment and processes to achieve the maximum profitable recovery of oil and gas. Petroleum engineers rely heavily on computer models to simulate reservoir performance using different recovery techniques. They also use computer models for simulations of the effects of various drilling options.

Only a small proportion of oil and gas in a reservoir will flow out under natural forces; therefore, petroleum engineers develop and use various enhanced recovery methods. These include injecting water, chemicals, gases, or steam into an oil reservoir to force out more of the oil, and computer-controlled drilling or fracturing to connect a larger area of a reservoir to a single well. Because even the best techniques used today recover only a portion of the oil and gas in a reservoir, petroleum engineers research and develop technology and methods to increase recovery and lower the cost of drilling and production operations.

Other Engineering Degree Areas In addition to the main engineering fields covered within this site, there are many accredited engineering programs in other areas. These include:

- Ceramic Engineering
- Construction Engineering
- Drafting and Design
- Engineering (General)
- Engineering Management
- Engineering Mechanics
- Engineering Physics/Engineering Science
- Forest Engineering
- Geological Engineering
- Metallurgical Engineering
- Naval Architecture and Marine Engineering
- Ocean Engineering
- Plastics Engineering
- Surveying Engineering
- Welding Engineering