



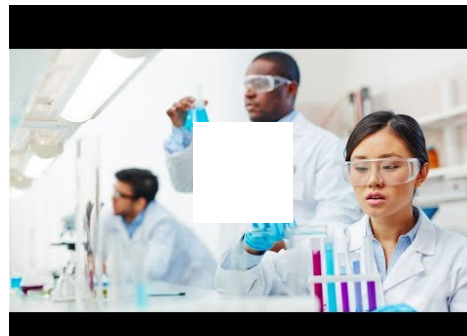
Chemical Engineers

Summary | What They Do | Work Environment | How to Become One | Pay | Job Outlook | State & Area Data | Similar Occupations | More Info

Summary

Summary

Quick Facts: Chemical Engineers	
2019 Median Pay	\$108,770 per year \$52.30 per hour
Typical Entry-Level Education	Bachelor's degree
Work Experience in a Related Occupation	None
On-the-job Training	None
Number of Jobs, 2019	32,600
Job Outlook, 2019-29	4% (As fast as average)
Employment Change, 2019-29	1,400



[What Chemical Engineers Do](#)

Chemical engineers apply the principles of chemistry, biology, physics, and math to solve problems that involve the use of fuel, drugs, food, and many other products.

[Work Environment](#)

Chemical engineers work mostly in offices or laboratories. They may spend time at industrial plants, refineries, and other locations, where they monitor or direct operations or solve onsite problems. Nearly all chemical engineers work full time.

[How to Become a Chemical Engineer](#)

Chemical engineers must have a bachelor's degree in chemical engineering or a related field. Employers also value practical experience. Therefore, internships and cooperative engineering programs can be helpful.

[Pay](#)

The median annual wage for chemical engineers was \$108,770 in May 2019.

[Job Outlook](#)

Employment of chemical engineers is projected to grow 4 percent from 2019 to 2029, about as fast as the average for all occupations. Demand for chemical engineers' services depends largely on demand for the products of various manufacturing industries.

[State & Area Data](#)

Explore resources for employment and wages by state and area for chemical engineers.

[Similar Occupations](#)

Compare the job duties, education, job growth, and pay of chemical engineers with similar occupations.

[More Information, Including Links to O*NET](#)

Learn more about chemical engineers by visiting additional resources, including O*NET, a source on key characteristics of workers and occupations.

What They Do

What Chemical Engineers Do

About this section

Chemical engineers apply the principles of chemistry, biology, physics, and math to solve problems that involve the production or use of chemicals, fuel, drugs, food, and many other products. They design processes and equipment for large-scale manufacturing, plan and test production methods and byproducts treatment, and direct facility operations.

[Duties](#)

Chemical engineers typically do the following:

- Conduct research to develop new and improved manufacturing processes
- Establish safety procedures for those working with dangerous chemicals
- Develop processes for separating components of liquids and gases, or for generating electrical currents, by using controlled chemical processes
- Design and plan the layout of equipment
- Conduct tests and monitor the performance of processes throughout production
- Troubleshoot problems with manufacturing processes
- Evaluate equipment and processes to ensure compliance with safety and environmental regulations
- Estimate production costs for management

Some chemical engineers, known as **process engineers**, specialize in a particular process, such as oxidation (a reaction of oxygen with chemicals to make other chemicals) or polymerization (making plastics and resins).

Others specialize in a particular field, such as nanomaterials (extremely small substances) or biological engineering. Still others specialize in developing specific products.

In addition, chemical engineers work in the production of energy, electronics, food, clothing, and paper. They must understand how the manufacturing process affects the environment and the safety of workers and consumers.

Chemical engineers also conduct research in the life sciences, biotechnology, and business services.

[← Summary](#)

Work Environment

[Work Environment →](#)

Work Environment

[About this section](#)

Chemical engineers held about 32,600 jobs in 2019. The largest employers of chemical engineers were as follows:

Research and development in the physical, engineering, and life sciences	10%
Engineering services	9
Petroleum and coal products manufacturing	5
Wholesale trade	4
Pharmaceutical and medicine manufacturing	3

Chemical engineers work mostly in offices or laboratories. They may spend time at industrial plants, refineries, and other locations, where they monitor or direct operations or solve onsite problems.

Chemical engineers must be able to work with those who design other systems and with the technicians and mechanics who put the designs into practice.

Some engineers travel extensively to plants or worksites, both domestically and abroad.

Injuries and Illnesses

Chemical engineers can be exposed to health or safety hazards when handling certain chemicals and plant equipment, but such exposure can be avoided if proper procedures are followed.

Work Schedules

Nearly all chemical engineers work full time. Occasionally, they may have to work additional hours to meet production targets and design standards or to troubleshoot problems with manufacturing processes. Some chemical engineers work more than 40 hours per week.

[← What They Do](#)

How to Become One

[How to Become One →](#)

How to Become a Chemical Engineer

[About this section](#)

Chemical engineers must have a bachelor's degree in chemical engineering or a related field. Employers also value practical experience, so internships and cooperative engineering programs, in which students earn college credit and experience, can be helpful.

Education

Chemical engineers must have a bachelor's degree in chemical engineering or a related field. Programs in chemical engineering usually take 4 years to complete and include classroom, laboratory, and field studies. High school students interested in studying chemical engineering will benefit from taking science courses, such as chemistry, physics, and biology. They also should take math courses, including algebra, trigonometry, and calculus.

At some universities, students can opt to enroll in 5-year engineering programs that lead to both a bachelor's degree and a master's degree. A graduate degree,



Chemical engineers develop and design chemical manufacturing processes.



Chemical engineers generally work in offices or laboratory settings, although sometimes they must work in an industrial setting to oversee production.

which may include a degree up to the Ph.D. level, allows an engineer to work in research and development or as a [postsecondary teacher](#).

Some colleges and universities offer internships and/or cooperative programs in partnership with industry. In these programs, students gain practical experience while completing their education.

[ABET](#) accredits engineering programs. ABET-accredited programs in chemical engineering include courses in chemistry, physics, and biology. These programs also include applying the sciences to the design, analysis, and control of chemical, physical, and biological processes.

Important Qualities

Analytical skills. Chemical engineers must troubleshoot designs that do not work as planned. They must ask the right questions and then find answers that work.

Creativity. Chemical engineers must explore new ways of applying engineering principles. They work to invent new materials, advanced manufacturing techniques, and new applications in chemical and biomedical engineering.

Ingenuity. Chemical engineers learn the broad concepts of chemical engineering, but their work requires them to apply those concepts to specific production problems.

Interpersonal skills. Because their role is to put scientific principles into practice in manufacturing industries, chemical engineers must develop good working relationships with other workers involved in production processes.

Math skills. Chemical engineers use the principles of advanced math topics such as calculus for analysis, design, and troubleshooting in their work.

Problem-solving skills. In designing equipment and processes for manufacturing, these engineers must be able to anticipate and identify problems, including such issues as workers' safety and problems related to manufacturing and environmental protection.

Licenses, Certifications, and Registrations

Licensure for chemical engineers is not as common as it is for other engineering occupations, nor is it required for entry-level positions. A Professional Engineering (PE) license, which allows for higher levels of leadership and independence, can be acquired later in one's career. Licensed engineers are called professional engineers (PEs). A PE can oversee the work of other engineers, sign off on projects, and provide services directly to the public. State licensure generally requires

- A degree from an ABET-accredited engineering program
- A passing score on the Fundamentals of Engineering (FE) exam
- Relevant work experience, typically at least 4 years
- A passing score on the Professional Engineering (PE) exam

The initial FE exam can be taken after one earns a bachelor's degree. Engineers who pass this exam are commonly called engineers in training (EITs) or engineer interns (EIs). After meeting work experience requirements, EITs and EIs can take the second exam, called the Principles and Practice of Engineering (PE).

Each state issues its own licenses. Most states recognize licensure from other states, as long as the licensing state's requirements meet or exceed their own licensure requirements. Several states require engineers to take continuing education to keep their licenses.

Other Experience

During high school, students can attend [engineering summer camps](#) to see what these and other engineers do. Attending these camps can help students plan their coursework for the remainder of their time in high school.

Advancement

Entry-level engineers usually work under the supervision of experienced engineers. In large companies, new engineers also may receive formal training in classrooms or seminars. As junior engineers gain knowledge and experience, they move to more difficult projects with greater independence to develop designs, solve problems, and make decisions.

Eventually, chemical engineers may advance to supervise a team of engineers and technicians. Some may become [architectural and engineering managers](#). Preparing for management positions usually requires working under the guidance of a more experienced chemical engineer.

An engineering background enables chemical engineers to discuss a product's technical aspects and assist in product planning and use. For more information, see the profile on [sales engineers](#).

[← Work Environment](#)

Pay

[Pay →](#)

Pay

The median annual wage for chemical engineers was \$108,770 in May 2019. The median wage is the wage at which half the workers in an occupation earned more



Becoming a chemical engineer requires a bachelor's degree in chemical engineering or a related field.

[About this section](#)

Chemical Engineers
Median annual wages, May 2019

than that amount and half earned less. The lowest 10 percent earned less than \$66,810, and the highest 10 percent earned more than \$176,090.

In May 2019, the median annual wages for chemical engineers in the top industries in which they worked were as follows:

Petroleum and coal products manufacturing	\$119,010
Research and development in the physical, engineering, and life sciences	116,250
Engineering services	112,990
Wholesale trade	100,510
Pharmaceutical and medicine manufacturing	98,160

A 2015 survey report by the [American Institute of Chemical Engineers](#) indicated that the median yearly salary of those with no supervisory responsibility was \$106,300.

Nearly all chemical engineers work full time. Occasionally, they may have to work additional hours to meet production targets and design standards or to troubleshoot problems with manufacturing processes. Some chemical engineers work more than 40 hours per week.

[<- How to Become One](#)
Job Outlook

[Job Outlook ->](#)

Job Outlook

[About this section](#)

Employment of chemical engineers is projected to grow 4 percent from 2019 to 2029, about as fast as the average for all occupations. Demand for chemical engineers' services depends largely on demand for the products of various manufacturing industries. The ability of these engineers to stay on the forefront of new emerging technologies will sustain employment growth.

Many chemical engineers work in industries whose products are sought by many manufacturing firms. For instance, they work for firms that manufacture plastic resins, which are used to increase fuel efficiency in automobiles. Increased availability of domestically produced natural gas should increase manufacturing potential in the industries employing these engineers.

In addition, chemical engineering will continue to migrate into dynamic fields, such as nanotechnology, alternative energies, and biotechnology, and thereby help to sustain demand for engineering services in many manufacturing industries.

However, overall growth of employment will be tempered by declines in employment in some manufacturing sectors.

Job Prospects

The need to find alternative fuels to meet increasing energy demand while maintaining environmental sustainability will continue to require the expertise of chemical engineers in oil- and gas-related industries. In addition, the integration of chemical and biological sciences and rapid advances in innovation will create new areas in biotechnology and in medical and pharmaceutical fields for them to work in. Thus, those with a background in biology will have better chances to gain employment.

Employment projections data for chemical engineers, 2019-29

Occupational Title	SOC Code	Employment, 2019	Projected Employment, 2029	Change, 2019-29		Employment by Industry
				Percent	Numeric	
Chemical engineers	17-2041	32,600	34,000	4	1,400	Get data

SOURCE: U.S. Bureau of Labor Statistics, Employment Projections program

[<- Pay](#)
State & Area Data

[State & Area Data ->](#)

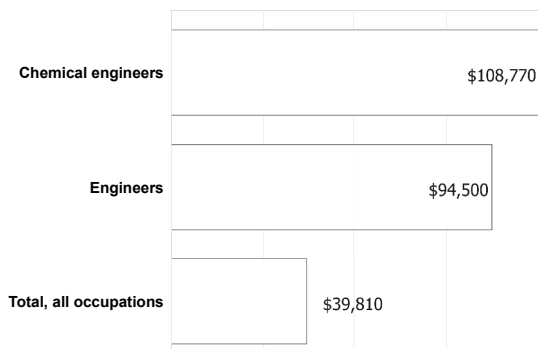
State & Area Data

[About this section](#)

Occupational Employment Statistics (OES)

The [Occupational Employment Statistics](#) (OES) program produces employment and wage estimates annually for over 800 occupations. These estimates are available for the nation as a whole, for individual states, and for metropolitan and nonmetropolitan areas. The link(s) below go to OES data maps for employment and wages by state and area.

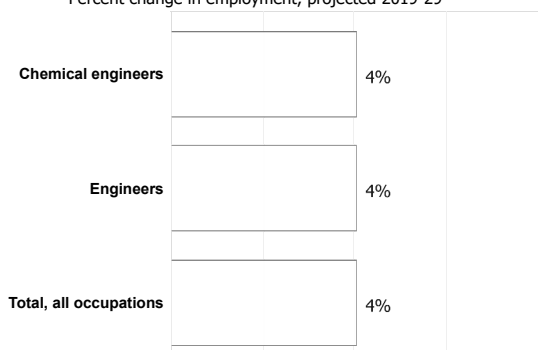
- [Chemical engineers](#)



Note: All Occupations includes all occupations in the U.S. Economy.
Source: U.S. Bureau of Labor Statistics, Occupational Employment Statistics

Chemical Engineers

Percent change in employment, projected 2019-29



Note: All Occupations includes all occupations in the U.S. Economy.
Source: U.S. Bureau of Labor Statistics, Employment Projections program

Projections Central

Occupational employment projections are developed for all states by Labor Market Information (LMI) or individual state Employment Projections offices. All state projections data are available at www.projectionscentral.com. Information on this site allows projected employment growth for an occupation to be compared among states or to be compared within one state. In addition, states may produce projections for areas; there are links to each state's websites where these data may be retrieved.

CareerOneStop

CareerOneStop includes hundreds of [occupational profiles](#) with data available by state and metro area. There are links in the left-hand side menu to compare occupational employment by state and occupational wages by local area or metro area. There is also a [salary info tool](#) to search for wages by zip code.

[← Job Outlook](#)









Similar Occupations

[Similar Occupations ->](#)

Similar Occupations

[About this section](#)

This table shows a list of occupations with job duties that are similar to those of chemical engineers.

	OCCUPATION	JOB DUTIES	ENTRY-LEVEL EDUCATION 	2019 MEDIAN PAY 
	Architectural and Engineering Managers	Architectural and engineering managers plan, direct, and coordinate activities in architectural and engineering companies.	Bachelor's degree	\$144,830
	Bioengineers and Biomedical Engineers	Bioengineers and biomedical engineers combine engineering principles with sciences to design and create equipment, devices, computer systems, and software.	Bachelor's degree	\$91,410
	Chemical Technicians	Chemical technicians use special instruments and techniques to assist chemists and chemical engineers.	Associate's degree	\$49,260
	Chemists and Materials Scientists	Chemists and materials scientists study substances at the atomic and molecular levels and analyze the ways in which the substances interact with one another.	Bachelor's degree	\$78,790
	Nuclear Engineers	Nuclear engineers research and develop the processes, instruments, and systems used to derive benefits from nuclear energy and radiation.	Bachelor's degree	\$113,460
	Occupational Health and Safety Specialists and Technicians	Occupational health and safety specialists and technicians collect data on and analyze many types of work environments and work procedures.	See How to Become One	\$70,480

[← State & Area Data](#)

More Info

[More Info ->](#)

Contacts for More Information

[About this section](#)

For more information on becoming a chemical engineer, visit

[American Institute of Chemical Engineers](#)

For information about general engineering education and career resources, visit

[American Society for Engineering Education](#)

[Technology Student Association](#)

For information about accredited engineering programs, visit

[ABET](#)

For information on internships opportunities, visit

[American Institute of Chemical Engineers Career Center](#)

For more information about licensure as a professional engineer, visit

[National Council of Examiners for Engineering and Surveying](#)

[National Society of Professional Engineers](#)

O*NET

[Chemical Engineers](#)

[<- Similar Occupations](#)

SUGGESTED CITATION:

Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook*, Chemical Engineers, at <https://www.bls.gov/ooh/architecture-and-engineering/chemical-engineers.htm> (visited March 02, 2021).

Last Modified Date: Monday, September 21, 2020

U.S. BUREAU OF LABOR STATISTICS Office of Occupational Statistics and Employment Projections PSB Suite 2135 2 Massachusetts Avenue NE
Washington, DC 20212-0001

Telephone:1-202-691-5700_ www.bls.gov/ooh [Contact OOH](#)