

# Energy Science and Technology

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## Overview

The Graduate Group in Energy Science and Technology sponsors a Designated Emphasis in Energy Science and Technology (DEEST).

Reliable and economical energy is essential for society to endure. Reliance on fossil sources has now created a dependence that, through progressive depletion in the not too distant future, may threaten the stability of economic systems and lead to serious, if not irreparable, environmental damage. To avoid future catastrophic global conflicts and damaging climatic changes, present energy technologies are required to operate at their highest possible efficiency with the lowest possible environmental impact. New technologies also need to be devised and deployed that are economic, renewable, and of low or zero climate impact. This compelling scenario is propelling the development of a distinct area of science and technology that is focused on supporting the needs of the global energy marketplace.

The development of future and even present-day energy sectors holds special challenges; many supply and demand technologies have lifetimes over multiple decades; appropriate forms of governmental oversight are not widely agreed upon, and the market entry of new technologies is often effectively impeded and increasingly encumbered by national security concerns. The looming energy and climatic problems are truly global issues that complicate and accelerate other problems — many energy markets are international in nature, and over the next two decades, commercial energy use in developing nations will soon surpass that in the industrialized nations.

A deepening of the understanding of factors that affect efficiency; more accurate modeling of systems and processes; study and discovery of new materials that enable innovative energy technologies; and effective management and policies are at the basis of continued dramatic change in a wide range of technologies. This may stimulate a revolution in energy technology systems and their management that will hopefully alleviate the pressing energy needs of present-day society and of generations to come.

The dominant energy sectors at present either rely on electricity generation from fossil sources or on liquid fossil fuels for transportation. The potential exists to change today's electricity systems to encourage and incorporate new supply and demand-side innovations, as well as innovative management policies. This would transform an enormous and vital component of U.S. infrastructure into one that provides greatly improved energy services, ensures energy diversity, is highly secure against market manipulation and terrorist attacks, and permits the provision of energy with greatly reduced regional and global environmental impacts. High-efficiency combustion systems can be devised that strongly increase the conversion from hydrocarbon fuel to energy. Based on new materials physics and materials chemistry, scientific advances and inventions in nanotechnology have opened the door to potentially affordable and efficient solar and thermoelectric power generation. Novel nuclear reactors using designer fuel with minimal waste generation can now be conceptualized, significantly reducing fossil-fuel consumption and nuclear waste, that in the coming decade will generate power without the inherent global warming from CO<sub>2</sub> emissions. Advances in the understanding of biochemistry open the door to carbon-

neutral technologies from biomass. Similarly, dramatic transformations can be expected in transportation systems, where new fuels, such as hydrogen or alcohols, could be produced in mass by solar, biomass, or nuclear technologies and be consumed in highly efficient fuel-cell or battery-powered vehicles. All this is possible, but it will require an unprecedented level of dedication to education and interdisciplinary energy study and research.

The Designated Emphasis in Energy Science and Technology (DEEST) advances these ongoing efforts at UC Berkeley and educates a new group of leaders for the global enterprise of creating future energy systems.

## Undergraduate Program

There is no undergraduate program in Energy Science and Technology

## Graduate Program

Energy Science and Technology (<http://guide.berkeley.edu/archive/2022-23/graduate/degree-programs/energy-science-technology/>): Designated Emphasis (DE)