Center for Energy Research- Creating solutions to the growing challenges of energy supply and use in society

Why Energy Matters

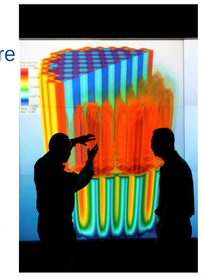
Our society needs energy to survive and thrive. Every activity costs energy- from home heating to food production to entertainment. However, the amount of useable energy is limited, and each energy source has risks and environmental impacts to consider. In 2012 the total installed electricity generation power capacity in the United States was 1.1 billion kiloWatts (kW). The actual electrical energy generation delivered was 4.0 trillion kiloWatt hours (kWh). Total energy consumption including waste and non-electrical sources was 30 trillion kWh. California is a leader in renewable energy, but 59% of electricity generation still comes from natural gas.

HYDROELECTRICITY harnesses the natural water cycle to store energy

- Flowing water turns turbines directly
- 1 gram H_2O atop Niagara Falls has 0.00000003 kWh.
- Very little new capacity can be added
- Transforms landscape
- CO_2-free

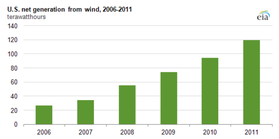
NUCLEAR FISSION generates abundant, carbon-free power

- Nuclear reactions release much more energy than chemical reactions
- Heated water turns turbines and a generator
- 1 gram of purified uranium contains 23,000 kWh of energy
- Expensive safety requirements
- Spent fuel must be stored long-term



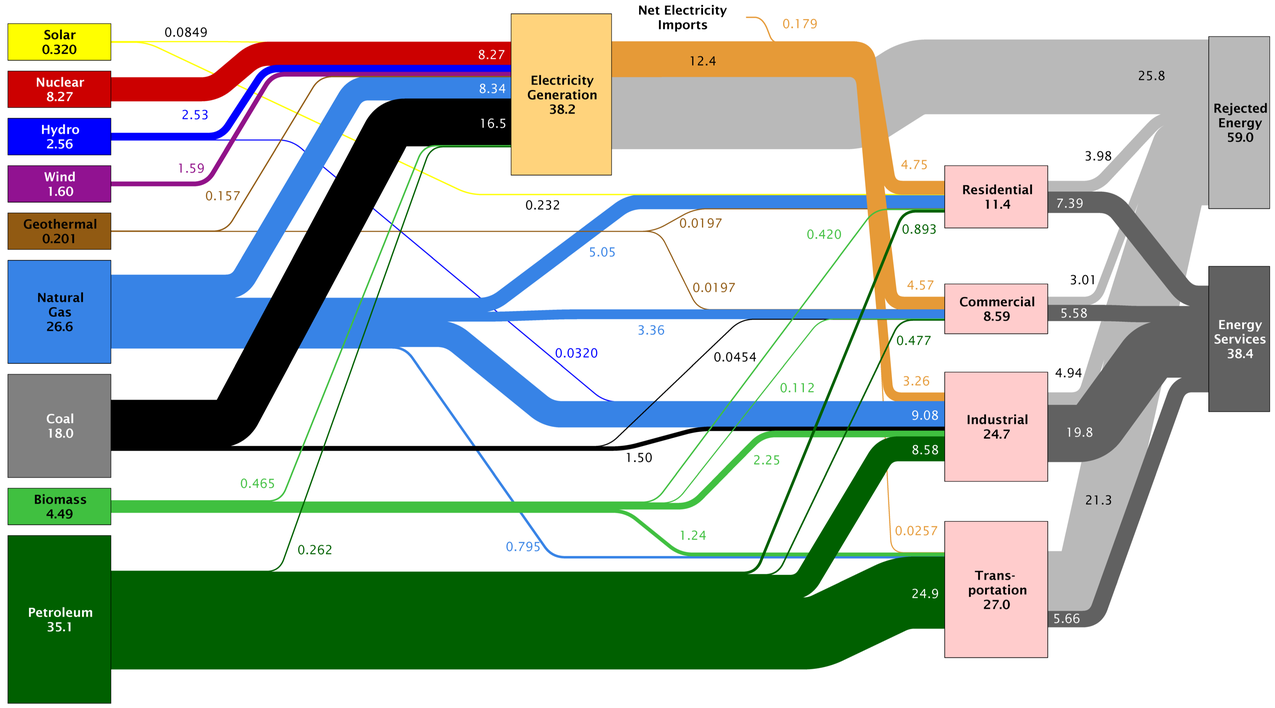
Turbines utilize prevailing WINDS

- Airflow turns turbines directly
- 1 turbine can generate over 100,000 kWh each day
- Capacity is growing rapidly and can continue in some places
- Transforms landscape
- CO_2-free



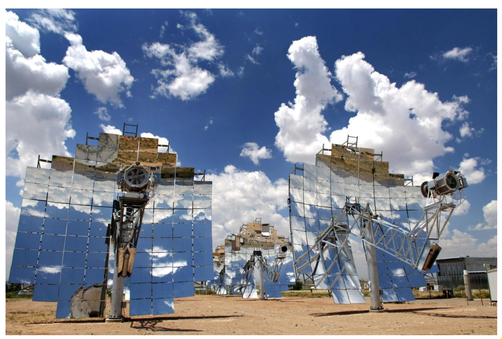
Estimated U.S. Energy Use in 2013: ~97.4 Quads

Lawrence Livermore National Laboratory



Photovoltaics and reflectors directly collect SOLAR energy

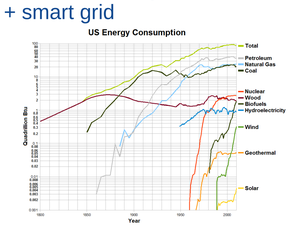
- Sunlight makes current flow in photovoltaic semiconductors
- Photovoltaics can be anywhere
- A typical southern California house top receives about 1000 kWh each day
- Reflectors concentrate sunlight to heat water
- Truly renewable and sustainable source
- Low CO_2



Replacing petroleum and other fossil fuels

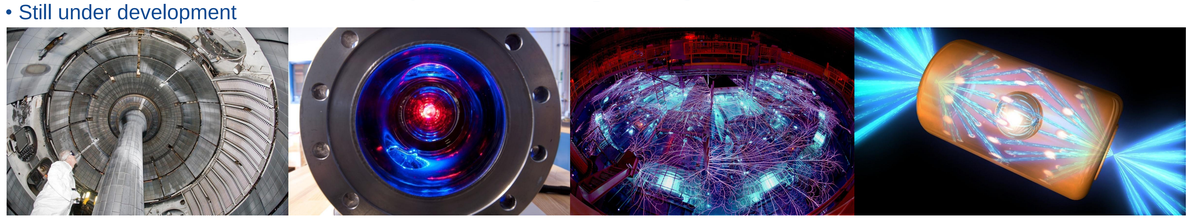
The largest sector of energy consumption is transportation, powered by petroleum. Gasoline from petroleum is portable and energy-dense (1 ounce contains 0.28 kWh), but it produces CO_2/pollutants and ***may run out during your lifetime***. Electric cars only transfer the demand to electrical power plants, which mostly burn fossil fuels. Some solutions include:

- Electric cars + sustainable electricity source
- Improved batteries + smart grid
- Fuel cell cars
- Alternative fuels



Nuclear fusion could be abundant and free of pollution and long-term waste

- The SUN is the only nuclear fusion power plant we have so far
- Hot, dense plasmas can be made on Earth using dense electric currents or intense lasers
- Potentially could have unlimited, universally available fuel, CO_2 free, long-term waste free
- Still under development



The Center for Energy Research (CER) was established at UC San Diego in 1972 to help create solutions to the growing challenges of energy supply and utilization in our society. Members of CER include internationally recognized scientists, faculty from multiple UCSD departments, visiting scholars from all over the world, and students. Together they perform basic and applied research in fusion, solar energy, fuel cells, energy storage, and related disciplines. CER also sponsors energy-related lectures, symposia, and academic conferences.

CER Mission Statement- With the industrialization of emerging nations, the world demand for energy will increase many fold in the next 50 years. Substantial research and development is required to develop new technologies for energy generation, distribution, and efficient utilization. In addition, it is necessary to train and educate the next generation of energy professionals. By their very nature, universities are ideally suited to carry out the fundamental research and education needed to create the knowledge base for the development of sound energy systems. As such, our mission statement is:

Creating solutions to the growing challenges of energy supply and use in society

Our vision and agenda for CER is to build an internationally recognized center of excellence in energy research and education by

- Creating an organization to foster interdisciplinary research
- Developing visibility & recognition for UCSD as a leading institution in energy studies
- Developing educational programs in energy technologies

Sources: Images from the U.S. Department of Energy, https://www.flickr.com/photos/departmentofenergy/
Energy data from the U.S. Energy Information Administration, http://www.eia.gov/