ENERGY

for a sustainable future

Remote sensing satellites help locate new sources of fossil fuel, geothermal energy, and other alternative energy solutions

Nanotechnology and optical fiber sensors contribute to fuel cell research and development

LEDs are saving energy in metropolitan areas

Energy and power

In 2003, the most recent year for which complete data are readily available, the world used on average 14.2 TW. The great majority of the energy came from fossil fuels. Oil alone provided some 39% of the energy used in the world in 2003. Another 24% was derived from coal and 23% came from natural gas. By comparison, fission reactors delivered only 6% of the world's energy, while hydropower and renewables accounted for 8%-nearly all of it from dams on the world's rivers. Thus far, nontraditional energy sources such as solar and wind deliver at most about 2% of the world's total energy supply.

Energy is not the same as power; in the simplest terms, energy is power multiplied by time. It is convenient to use an average-power measure given in watts (W) as a measure of instantaneous consumption. A source providing one kilowatt (kW) of power provides 1 kJ of energy per second, or 3,600 kJ per hour. This is more familiar in the wider community as a kilowatt-hour (kWh).

For those who derive their energy from oil, the standard unit is the barrel of oil (BO), and the tendency is to work in barrels of oil consumed, not the energy produced. In 2003, world energy consumption was 123,000 TWh, or 443 EJ (443 billion billion joules; 1018 J = 1 exajoule [EJ]) or 579 Mtoe (million tons of oil equivalent), which is approximately 4,226 million BO.

Data from OECD

This Solar Dish, provides enough energy to power over one dozen homes

Photovoltaics: a bright future

Apart from the ubiquitous use of biomass, the two engineered approaches to using solar energy currently in widest use are "solar thermal" and solar photovoltaic. Solar thermal can be as simple as using the sun to heat water in blackened pipes, but more sophisticated approaches use focused sunlight to convert heat to electrical power by using Stirling engines. Photovoltaics, a.k.a. "solar cells," convert sunlight into electrical power and are in widespread use from satellites to calculators. The efficiency of solar photovoltaics systems has improved gradually and holds the promise of further significant improvements.

LEDS light the world for an African man, and children in Sri Lanka

Solar-powered water pumps for wells in third world countries

Debby Tewa working on providing photovoltaic energy to Native Americans in remote areas

Take up the technical challenges of sustainable energy.

Energy consumption is predicted to increase 50% by 2030 and almost double by 2050. Conventional carbon-based sources, while plentiful, degrade our environment, perhaps with catastrophic consequences. Nuclear power has promise and dangers but is not a renewable source, and known fuel supplies cannot meet our growing needs for more than a few decades. Terrestrial fusion sources could be the ultimate answer, if we can harness the promise, but it still seems 50 years off, as it has for the last 50 years.

What about our life-sustaining fusion source, the sun? Solar energy is superabundant, clean and attainable. It is the only renewable source that can supply projected future energy needs.

Solar energy has the advantage of being available everywhere; it can be used to power phones in far-flung regions, drive water pumps in developing areas that lack electrical distribution systems, and run heating and electrical systems in homes in the energy-hungry developed world. The use of solar systems simplifies energy distribution, but challenges remain in energy storage; here again scientists and engineers have the opportunity to contribute.

It's your future—invent it!

SPIE

SPIE.org

IEEE photonics SOCIETY formerly LEOS

PhotonicsSociety.org

Building a better future with light

Photovoltaic and fuel cell images courtesy of Sandia National Laboratory