NREL FACTS

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NREL FACILITIES

NREL's Solar Energy Research Facility

...converting sunlight into electricity

NREL's Solar Energy Research Facility (SERF) is a state-of-the-art research facility for developing technologies that convert sunlight into electricity. Completed in October 1993, SERF houses 42 laboratories where about 170 employees pursue research in photovoltaics (PV), superconductivity and related material sciences.

The 115,000 square-foot facility cost $19.6 million, or about $170 per square foot for design and construction—less than half the cost of a typical research facility. The facility was designed and constructed to meet or exceed all applicable environmental, safety and health codes and standards. It incorporates numerous energy saving features that make it one of the government's most energy efficient buildings.

Energy Conservation

SERF was designed and built to use less energy and take advantage of sunlight. Annual energy costs for the building's lighting, heating and cooling, and auxiliary power equipment were expected to be 42% lower than a similar building designed to meet federal standards. Total annual energy costs (including energy used for laboratory work) were expected to be 30% lower than the federal standard. A subsequent audit of the building's energy use showed that energy costs for lighting, heating and cooling, and auxiliary power equipment were actually 51% lower, while total energy costs for the building are 36% lower than the federal standard.

Energy Efficient Features

SERF was sited intelligently, its back nestled into the hillside to take advantage of natural insulation of the mesa to the north. Its front faces a few degrees off of due south to capitalize on sunlight for heating and daylighting in the three contiguous modules. Each module has an office pod in the front and a laboratory pod in the back. This design allows extensive use of daylighting in the office areas and a more controlled laboratory environment separate from the offices.

Daylighting—office areas and adjoining corridors are lit by sunlight, greatly reducing the need for artificial lighting. Since artificial lighting generates considerable amounts of heat, cooling costs are reduced. Highly reflective interior surfaces enhance daylighting.

Energy-Efficient Lighting—standard office fluorescent lights operate at 72 watts. SERF's high-efficiency lights use only 52 watts of power and provide similar lighting levels.

Window Shades Controlled by Photovoltaic Sensor—glare and solar heat gain are managed by sensor-controlled, motorized shades that automatically raise and lower based on the sun's intensity.

Direct Evaporative Cooling—uses evaporation to lower air temperature and increase humidity, and then distributes air throughout the building. Direct evaporative cooling uses less energy than conventional air conditioning.

Indirect Evaporative Cooling—an intermediary heat exchanger is used to cool air streams without using water vapor. It can also be used to cool a closed-loop system, such as is used to cool the building and equipment.

Laboratory Exhaust Heat Recovery—a heat exchanger recovers heat generated by equipment and lights and uses it to preheat fresh, incoming air, displacing 50% to 60% of the energy that would otherwise be required to heat incoming air.

High-Efficiency Motors—use 2% to 3% less electricity than standard motors to produce the same mechanical output.

Variable Frequency Drives—fan rotors used for ventilation are operated at the speed and power needed to meet demand, unlike conventional systems that operate at maximum power.

Upsized Cooling Tower—oversized to provide more contact area between water to be cooled and the circulating air stream. Air-flow pressure drop is reduced, and less fan horsepower is required to provide the same cooling tower performance.

Selective Glazing—used in certain areas of the building to reduce direct solar heat gain.

Trombe Wall—a 16-inch thick, concrete wall, coated with a dark, heat-absorbing material and covered with glass functions as a massive heat trap in winter to deliver solar heat inside to heat the shipping and receiving area. In summer, little direct sunlight strikes the wall because of the sun's position in the sky.

Laboratories

SERF provides scientists with laboratory space that was specifically designed to support internationally recognized photovoltaic and related technology development. The laboratories are composed of two parallel rows of bays separated by a 14-foot-wide service corridor.

Materials Research

Laboratories on the first floor of SERF's west module are used to develop semiconductor material for high-efficiency crystalline solar cells. Researchers from these labs have made a 29.5% efficient Gallium Indium Phosphide/Gallium Arsenide solar cell, a world record for solar cell efficiency. Efficiency is the amount of sunlight a solar cell converts into electricity.

Materials for thin film solar cells and superconductors are fabricated in labs on the second floor. Thin film solar cells are about 50 times thinner than crystalline solar cells and are easier to make. With an efficiency of 17.7%, NREL's Copper Indium Gallium Diselenide solar cell holds the world record for a thin film device.

Device Fabrication

Prototype solar cells are fabricated in laboratories in the center module. These labs include a device development laboratory and a clean room where air and light are filtered to minimize impurities in the solar cells. The center module also includes laboratories to analyze the semiconductor material used to make solar cells, and for research into hydrogen generation and storage.

Measuring Performance

Labs in the east module are used to measure and characterize the performance of solar cells and modules made by NREL researchers, industry partners and univer-sities. NREL conducts more than 17,000 measurements each year. Researchers analyze materials, characterize device performance, evaluate fabrication problems and model solar cell and module performance with computers.

PV Systems

On top of SERF's east and west office pods, 10 photovoltaic panels have been installed to study the performance of integrated PV systems on commercial buildings. The panels generate as much as 12 kilo watts of electricity that is fed into the Public Service Company of Colorado's power grid.