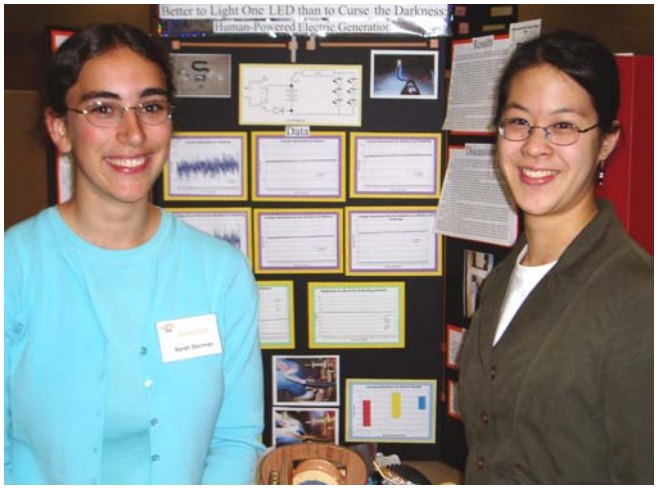
IMAGINING TOMORROW: ALTERNATE ENERGY FUTURES

Presented by The Northeast Sustainable Energy Association NESEA



Clean Energy Award
Region IV: Northeastern MA

Catherine Chan-Tse
Sarah Sterman,
Lexington High School

"Better to Light One LED: Human Powered Electric Generation"

Catherine Chan-Tse and Sarah Sterman are both sophomores at Lexington High School. They are best friends and long-time science partners: in 2006 they did a project on photovoltaics for the Massachusetts State Science Fair.

Catherine's main interests are science, engineering, and music. Sarah enjoys studying Latin and Chinese and playing the viola. In her spare time, she enjoys spinning wool and weaving, as well as rock climbing.

THE PROJECT: This year their project involved human-powered electric generation.

Environmental concerns and limited access to affordable energy, particularly in the developing world, call for innovative ways to generate clean, renewable power. We designed and built a device that generates electricity and powers an array of LED lights using the energy generated by a person pedaling a spinning wheel. This device can be used to light the work area while a person is spinning, power other small devices, or charge batteries without using grid electricity, providing a portable, nonpolluting, and renewable source of power.

The device can be used in areas without electricity to provide bright, safe, and clean lighting after dark instead of kerosene lanterns, which are not very bright, have a potentially dangerous flame, and produce smoke that is detrimental to human health. It is also useful in areas with electricity as an alternative to grid power, and as a way to help prevent obesity, because it provides an easy and productive way to keep moving in a sedentary society.

ABSTRACT: The final design of the device consists of a DC motor on a wooden stand to act as a generator, a 12-volt battery to store energy for use when one stops pedaling and to act as a buffer for the LEDs, a flexible lamp neck to position the array to light the work area, and an array of LEDs to provide light; all attached to the frame of an Ashford Joy spinning wheel. A rubber tire mounted on the axle of the motor contacts the flywheel of the spinning wheel, driving the axle of the motor to generate electricity as the wheel spins.

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Substantial experimentation with different design concepts was carried out. We explored a wide range of concepts for the mechanical linkages, the generator design, and the circuitry for the load and batter-charging functions. The final design uses readily available components with low costs. Costs could be lowered further under volume production. The final design allows power to be generated when the wheel is spun in either direction and contains circuitry to prevent the battery from driving the motor.

Once we had the device working, we performed three sets of tests using Vernier LabPro voltage, current, and light probes.

The first test showed that the battery is necessary for steady generation of electricity. This provides a steady light from the LEDs and buffers them against surges or deficits of power arising from variations in the rate of spinning. The second test documented the range of current and voltage produced by the generator at different pedaling speeds, the maximum current and voltage recorded being about 0.07 amps and 10.1 volts. The third test showed that the light produced by the LEDs at the distance needed for working is comparable to that produced by a 60-watt incandescent bulb, is bright enough to read easily by, to light an entire room, and to extend brightly over 9 meters (30 feet) outside at night.