Human Power Generation at the Recreational Sports Facility at UC Berkeley

Maha Haji, Kimberly Lau, and Alice M. Agogino, Ph.D.,
Department of Mechanical Engineering, University of California, Berkeley 94720

Abstract

As energy usage across the world continues to rise, there is a strong need to develop new methods for power generation that have less environmental impacts. Human power presents an alternative for energy harnessing, and a readily available resource can be easily found in the users of fitness facilities. This project focuses on the Recreational Sports Facility (RSF) at University of California, Berkeley, which averages 4,000 patrons per day. In particular, it was measured that patrons using 28 elliptical machines would supply approximately 11,246 kWh into the electric grid over a year. This amounts only to 0.78% of the RSF's total energy needs, but is valuable nonetheless. An additional benefit in human power generation is its positive social impact. This project focuses on the technical feasibility and social benefits of human power generation technology in the gym.

Figure 1: *Group spinning class exercise on stationary bicycles*

Introduction

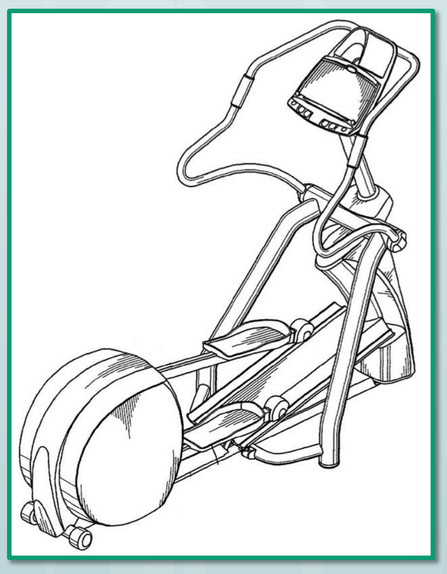

Figure 2: *Typical elliptical trainer. (US Patent 2003/0166434A1)*

University recreation centers around the nation have already begun harnessing human-power as a source of alternative energy. One of the most popular pieces of cardio equipment, the elliptical trainer (Fig. 2), has proven to be the most viable candidate for harnessing human power. Ellipticals provide a low-impact exercise that simulates the motion of walking or running. Many modern day ellipticals create training resistance by using an eddy current braking system. This system works by creating eddy currents through electromagnetic induction over a set of resistor coils located at the back of the machine. At the same time, the creation of resistance results in excess energy, which is currently dissipated as heat. In gyms across the nation, this energy is harnessed as direct current (DC) power and then converted to alternating current (AC) power by using an inverter to create the training resistance in the machine instead of electromagnetic induction. This AC power can then be fed back into the electric grid of the fitness facility.

Analysis

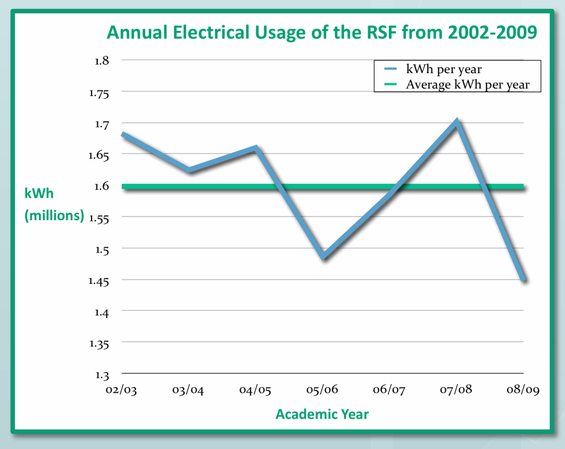

Figure 3: *Annual electricity usage (kWh) of the RSF over the past seven years*

Methods

Elliptical Retrofit

We plan to modify all 28 elliptical machines at the RSF to harness energy into useful electric power. The modification entails replacing the current build-in resistance mechanism with a DC/AC micro-inverter to convert the patron's direct current into usable alternating current for the electric grid (Figure 7). This AC power can then be supplied to the RSF electric grid.

Educational Campaign

This project can also have significant social impact on the energy harnessing movement. We plan to install a human power generating elliptical-and-laptop console at the RSF, where users can experience firsthand the "power" they are generating through a pedal-power system (Figure 8). More specifically, users will exercise on this elliptical, and watch a laptop turn on from their energy. We hope that the opportunity to see their direct energy potential will encourage usage of more-energy-efficient machines or more sustainable exercise choices, and ultimately, more sustainable lifestyle choices.

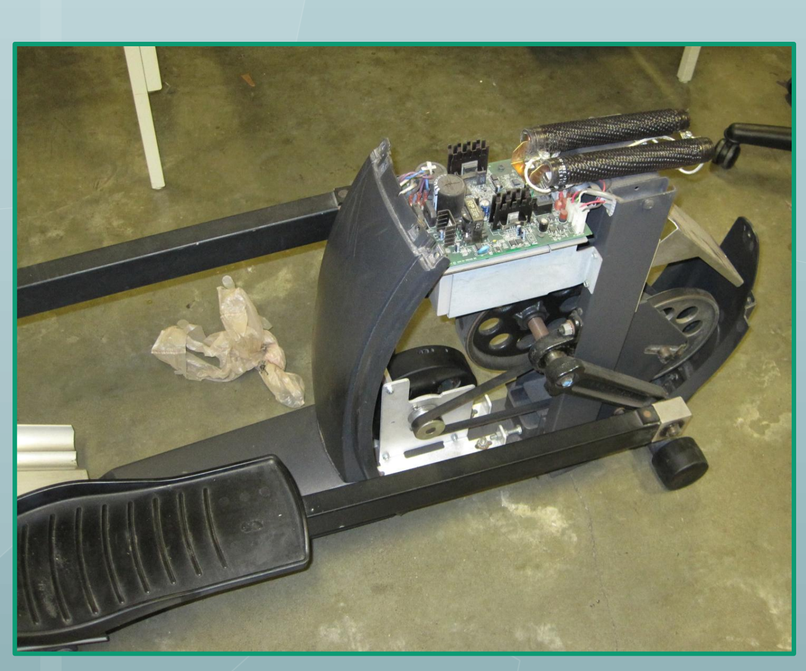

Figure 7: *Elliptical circuitry and coils*

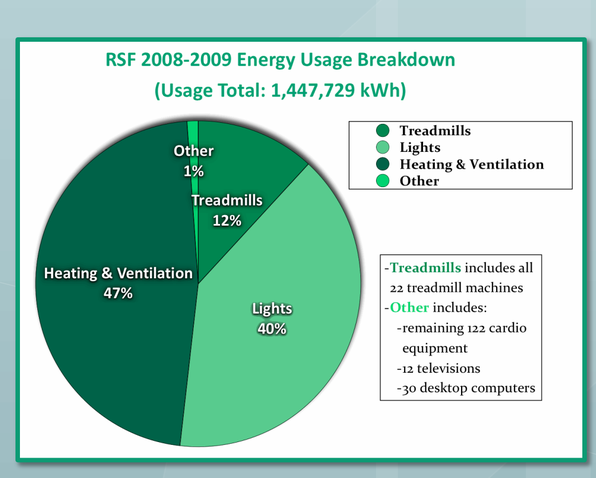

Figure 4: *RSF 2008-2009 energy usage breakdown*

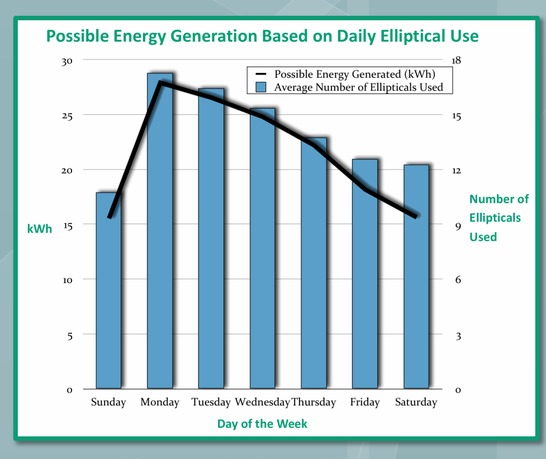

Figure 5: *Possible energy generation (kWh) from elliptical use*

Conclusion

The Recreational Sports Facility at the University of California, Berkeley, is one of the most energy efficient recreational centers surveyed. Because the facility is already employing methods of energy conservation, energy generation is the next step in reducing the center's carbon footprint; this project will help propel the RSF in that direction.

Figure 8: *Elliptical-and-laptop educational console*

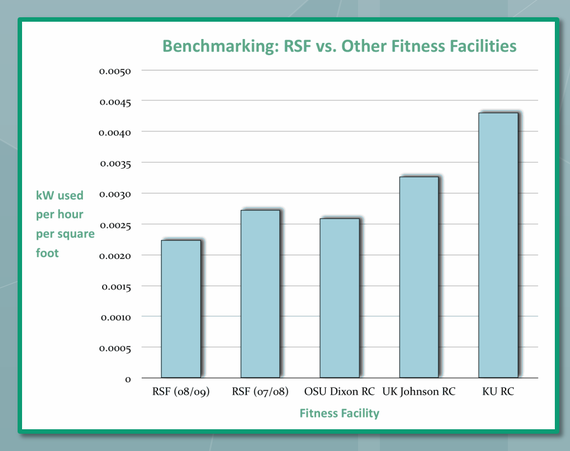

Figure 6: *Benchmarking RSF with other fitness centers of similar size and usage*

Timeline

Spring 2011 – Complete pedal-powered laptop educational console

Fall 2011 – Complete prototyping elliptical energy harnessing system

Fall 2011 – Retrofit elliptical machines in the RSF to harness human power

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