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Preliminary Research:

Gym Equipment Energy Generation & its Implementation at UC Santa Cruz Wellness Center

Background

Every day, UCSC students, staff, and faculty use the exercise machines in the Wellness Center gym at the Office of Physical Education, Recreation, and Sports (OPERS). Their movement on the machines currently just helps build muscle and burn calories, but it has the potential to actually power a portion of the gym's energy needs. Though the output wouldn't be enough to run the gym completely, why not harness the energy that could potentially be generated every day? The message that energy-generating gym equipment sends to gym users is itself powerful, particularly at a university that prides itself on its sustainability efforts and emphasis on innovative research.

How energy-generating machines work

Many exercise machines already have a small generator that powers "the monitoring console and also serve to increase the amount of resistance the user feels when exercising" (Gibson 2011). Instead of wasting the energy from gym equipment, Hudson Harr, founder of the equipment-retrofitting company ReRev, describes that his company "remove[s] the internal resistance the machine has and give[s] it an external load, which is [their] equipment." To convert the DC power from the machines to AC, they hook up the machines "to a central unit containing an inverter" that then provides energy for the building.

A number of companies, like ReRev, retrofit existing equipment to make them into energy-generators. The Green Revolution is another company that converts equipment, focusing on stationary bicycles. Using a car alternator, their retrofit equipment "attaches directly to the bikes, feeding electricity to two 12-volt batteries wired in series. When a user starts pedaling, the batteries charge, and when they're full, the inverter kicks in and sends power to the grid, converting 24-V DC to 110-V AC" (Gibson 2011).

Retrofitting equipment is an ideal method for creating an energy-generating gym because it costs less and turns equipment that already works into energy-generating machines. New machines may be more energy efficient and designed specifically for energy generation, but for gyms that already have a full set of equipment, it makes more sense in terms of resource conservation to convert equipment and wait until it's outdated or no longer works before purchasing new, energy-generating equipment.

What types of equipment can be converted?

Aerobic gym equipment machines, including elliptical trainers, steppers, and stationary bikes can be converted so that when users exercise on them, electricity is generated (Gibson 2011). Some companies are creating their own gym equipment specially designed to optimize energy generation, and some of these machines can be hooked up together so that the total energy is coming out of one collective source. One example includes not only a typical stationary bike piece, but also combines this with an arm workout portion to increase the amount of energy and workout (Gibson 2011).

How much energy can be generated?

On average, a professional or "elite cyclist can produce more than 400 watts, more than half a horsepower, for an hour or more at a stretch. But the average person, even somebody in good

shape, can generate only 50 to 150 watts during an hour of strenuous exercise" (Gibson 2011). The ReRev company states that using their retrofitted system, "a 30 minute workout on an elliptical cross-trainer will generate around 50 Watts of power, which is enough to power a CFL bulb for 2.5 hrs, to charge a cell phone 6 times, to run a laptop for 1 hour, or a desktop for 30 minutes" (Meinhold 2010). While not a significant amount, this is capturing energy potential that already exists every day in gyms around the world.

Economics & Carbon Emissions

While current technology for converting human powered energy to electricity isn't efficient enough to make a solid economic argument, it's worth exploring the cost-savings associated with the amounts of energy being generated.

In terms of one gym, Tom Gibson breaks down the energy use and associated cost-savings in his article "These Exercise Machines Turn Your Sweat Into Electricity": "Let's assume that the average piece of exercise equipment is in use 5 hours a day, 365 days a year. If each patron generates 100 watts while using it, that machine creates some 183 kilowatt-hours of electricity a year. Commercial power costs about 10 cents per kilowatt-hour on average in the United States, so the electricity produced in a year from one machine is worth about US $18 dollars" (Gibson 2011). Certainly, the cost-savings and kilowatt-hours of electricity generated depends on the hours the gym equipment is in use, and the OPERS Wellness Center is open 15 hours a day on weekdays. If one piece of equipment was in use, say, even only 10 hours a day on average, it would generate 366 kilowatt-hours of electricity and $36 a year. Multiply this times the number of pieces of equipment in OPERS that could become electricity generating, and the amounts of energy and cost-savings increase.

Just to put these numbers in perspective, 183 kilowatt-hours of electricity for the whole year is the equivalent of the carbon dioxide emissions from 14.5 gallons of gasoline consumed ("Greenhouse"). That's the fuel tank capacity of a 2013 Volkswagen Jetta sedan (2013 Volkswagen), which isn't a whole lot on its own. Again, isolating one machine doesn't create a huge economic or environmental incentive, but on a larger scale and with an educational component qualitatively added, the power of the transition to energy generating equipment increases.

For some commercial gyms, it's more about the marketing aspect of being a "green business" that makes the conversion to energy-generating equipment economically driven. For UCSC's Wellness Center, perhaps the same could be said in terms of drawing in more students to attend a university where their efforts to stay healthy and fit also reduce the carbon emissions of the campus, even if it's a small amount. Many people who hear about energy generating equipment have no idea how much energy is actually created, so for the purposes of marketing a "green gym," there is some possibility of this being viable in some way.

Despite this negligible dollar amount of savings, on a statewide or nationwide scale, harnessing the energy generated by gym equipment that will be used either way can provide a significant amount of watts that can offset the amount of fossil-fuel-sourced energy used. The same kind of concerns over economic incentives occurred with the introduction of compact fluorescent light bulbs and wind and solar energy (Gibson 2011). Over time as energy-generated gym machines become more widespread, the technology will likely become less expensive and perhaps will become the expectation in gyms everywhere. Again, the potential exists to be generating electricity; it just takes some money to convert the equipment, and then the energy can be added to the grid.

Educational Reasons

What better way to educate our campus community about the need to conserve energy than to help UCSC-affiliates make the connection between how much effort is required by the human body to generate a certain amount of energy? Not to mention that when people exercise, their thoughts can wander to a vast range of topics and oftentimes, it's a time that helps clear people's minds. Placing alternative energy generation at the front of their minds each time they hop on a machine inevitably will lead students and other users to consider these issues and could potentially lead to some innovative ideas about environmental conservation. This is actually the reason behind some universities' transition to energy-generating gyms.

Other Universities' Experiences

For the University of Oregon, the educational experience for students using their energy-generating gym is more important than the cost savings or actual energy generated (Barnard 2009). University of Oregon was able to divide the "the $14,000 cost with the local utility, Eugene Water and Electric Board" to use ReRev's retrofitting equipment on "20 Precor elliptical machines."

Their gym also has "a meter to keep track [energy] before it flows into the grid" (Barnard 2009), which has allowed them to have competitions with Oregon State University, their in-state rival. The tracking technology of these machines "make[s] it easy to engage in competitions with facilities on the other side of town or on the other side of the country, as well as create new fundraising and educational opportunities" (Popke 2011). University of Oregon and Oregon State University have had "Civil War" competitions on their energy-generating equipment over the past few years, leading up to their "Civil War" football games (Popke 2011). According to a report on the project, "While it will take several years for the machines to recoup their cost, that

is not why they were installed. Instead, they provide a visceral experience with a kilowatt hour. Simply understanding that unit of measurement and the energy required to produce it encourages students to engage in broader issues of conservation and renewable energy production" (Lewiston 2010). More information about this competition and the installation of equipment is outlined in the "UO vs OSU Energy Civil War" submission on the Association for the Advancement of Sustainability in Higher Education website.

UC Santa Cruz isn't known for it's sports competitiveness or school spirit as is seen at schools like University of Oregon, but perhaps in the realm of sustainable energy generation, it could find its competitive edge.

Possible Future OPERS Expansion & Need for More Funding

There is a need for an extended fee referendum in the coming years to continue the funding that OPERS receives for its maintenance (Lomberg 2013). In 2017, the fee will terminate unless students vote to approve continued funding. There is also a lack of space in the Wellness Center and other OPERS facilities for the growing population of students and staff at the University, so there will likely be a move to increase the fee amount. With these changes taking place and the possibility of renovations in the coming years, perhaps there is a way to access funding for gym equipment renovations to convert them to energy generators that could coincide with or support getting funding for expansion of the gym.

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