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Exercise converted to electricity

Stationary bikes in gyms, eateries, even a jail wired to produce power

By Wendy Koch
USA TODAY

Pedal power is gaining traction as thousands of bikes and elliptical machines are retrofitted to produce electricity.

Gyms are using sweat equity to help power their facilities. A Brooklyn eatery uses it to make smoothies. Female inmates at a Phoenix jail pedal to power their TV to watch soap operas. Actor Ed Begley Jr. bikes to run his toaster.

"Business is really taking off," says Jay Whelan, CEO of The Green Revolution, a Connecticut-based company that retrofits bikes for spinning classes. Since April 2009, he has added devices to nearly 1,000 bikes at 60 gyms that convert the direct current created by pedaling into alternating current to be sent to the power grid. Most of his customers are on the West or East Coast or in Canada. The average cost: about $1,000 per bike.

ReRev, a Florida company, has added similar devices to more than 300 elliptical trainers at 23 gyms in a dozen states since June 2008. Eleven of those facilities were retrofitted this year in Pennsylvania, Florida, Arkansas, Texas, Arizona and Oregon.

"It's a low-cost way to get into the renewable energy game," says Beth Bennion, ReRev's marketing director. She says the novelty attracts users. She asks, "Who would ever have thought we'd capture energy from a workout?"

Pedal power cannot run factories, but Whelan estimates a spinning class of 20 people over a year could light 72 homes for a month. ReRev says a 30-minute workout on one of its ellipticals generates about 50 watts, enough to run a laptop for an hour or charge a cellphone six times. "We're not going to solve global warming, but we're trying to help in any way we can," Whelan says.

At the Habana Outpost restaurant in Brooklyn, N.Y., it takes about a minute of bike pedaling to power a blender. "You get $1 off if you pedal your own smoothie," says Elvis Rosa, a manager. Most customers saddle up.

"It's been a wild success," says the Rev. Faith Fowler of Cass Community Social Services, which runs a homeless shelter in Detroit. She got a donation to retrofit 10 bikes at the shelter's gym to provide some of its electricity. She says she pursued the idea for both environmental and health reasons, noting that many residents struggle with diabetes and obesity. "It was a natural fit," Fowler says.

She says the residents became so much more eco- and health-minded that they began growing organic produce.

"It's a huge motivator," says Leah Loeffert, a government consultant who takes a spinning class at Washington Sports Club in the nation's capital.

Loeffert says the bike, by telling her how much power she produces, pushes her to work harder. She says she likes doing something for the environment and because she lives in a condo, she can't buy rooftop solar panels.

Maricopa County, Ariz., Sheriff Joe Arpaio sees such bikes as a solution for couch potatoes. In April, to get overweight inmates to exercise, he hooked one up to a TV in the women's section of his Tent City jail in Phoenix. The 19-inch TV works only if an inmate pedals.

All the women in that section of the jail signed up for the "pedal-vision program," he says. "Give them access to their favorite soaps and cop shows," he says, "and they'll pedal till the cows come home."

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Introduction

While most of today's discussion around green energy production only includes the harnessing of macro environmental sources (wind, solar), there has begun to emerge a new breed of entrepreneur whose more micro approach to the issue is making a difference to society in general and to one's bottom line in particular. Such is the case with producing real, usable electricity by the retrofitting of thousands of exercise bikes and elliptical machines found in health clubs and businesses around the country.

What are the large-scale implications for such a creative venture, and just how valid are claims made by the two retrofit-company spokespeople quoted in the "Exercise Converted to Electricity" article? What is the rate of those bike and elliptical conversions, and how much electricity can actually be produced in this way? In the exercises below, you will perform scale conversions and related computations to access the information necessary to address some questions regarding economy and ecology.

Materials needed

- Paper and pencil
- Calculator (for checking purposes only)

Economy (45 minutes)

Speaking on behalf of The Green Revolution, a Connecticut-based retrofitting company, was Jay Whelan, Chief Economic Officer.

1. Mr. Whelan quoted retrofit-sales numbers for his company since April 2009. Assuming continuous sales up to and including the month this article appeared in USA TODAY (August 2010), how many months of retrofit sales are being measured?

2. If The Green Revolution has retrofitted 1,000 bikes at 60 gyms, what is the average number of bikes retrofitted per gym (rounded to the nearest whole number)?

    - To the nearest whole number, what is the average number of bikes The Green Revolution has retrofitted per month?

    - To the nearest hundredth, what is the average number of bikes The Green Revolution has retrofitted per gym per month?

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Economy (continued)

The other retrofitting company cited in the article was the Florida-based firm ReRev, whose spokesperson is Beth Bennion, Marketing Director.

3. Ms. Bennion quoted retrofit-sales numbers for her company since June 2008. Assuming continuous sales up to and including the month this article appeared in USAToday (August 2010), how many months of retrofit sales are being measured?

4. If ReRev has retrofitted 300 bikes at 23 gyms, what is the average number of bikes retrofitted per gym (rounded to the nearest whole number)?

    - To the nearest whole number, what is the average number of bikes ReRev has retrofitted per month?

    - To the nearest hundredth, what is the average number of bikes ReRev has retrofitted per gym per month?

5. To the nearest whole number, what is the per-gym-per-month ratio of The Green Revolution's sales to ReRev's sales? Explain how you arrived at your answer.

Ecology (45 minutes)

A watt is a measure of the rate in which energy is converted and is equal to 1 joule of energy transferred per second. When 1,000 watts of electricity are used in one hour (= 1,000 watt-hours), it is more common to call it a 1 kilowatt-hour (= 1 kWh).

1. If the average house uses roughly 10 million watt-hours per year, how many kWh would that be?

    - If the average house uses 28 kWh per day, how many watt-hours would that be?

2. "(Mr.) Whelan estimates a spinning class of 20 people over a year could light 72 homes for a month." If a 20-person cycling class can generate anywhere from 2.5 to 3 kWh, is Mr. Whelan's statement accurate? Explain your reasoning.

3. "ReRev says a 30-minute workout on one of its ellipticals generates about 50 watts, enough to run a laptop for an hour..." At that rate of generating electricity, if 4 retrofitted ellipticals are pedaled for 45 minutes each, how long could 3 laptops stay charged?

4. Suppose we own a health club and retrofit one of our ellipticals from ReRev at a cost of $1,000.

    - If the national average price of electricity is $0.15 per kWh, how many 30-minute workouts would there need to be before we recoup our $1,000 investment?

    - Pedaling non-stop (24 hrs./day, 7 days/wk.), about how many years would that take?

5. During one particularly hot week in the summer, we leave our air conditioner on 24/7. It takes roughly 3 kWh to run our air conditioner. For the amount of energy used by the air conditioner for a week, how many days (at 28kWh per day) would we have been able to supply electricity to our house with the air conditioner turned off?

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Teacher's guide

Concepts

Numbers, operations, rounding, fractions, decimals, scale conversion, dimensional analysis, scientific notation, ratio, proportion, equations, real-world problem solving

Objectives

Students will:

- Solve problems involving the multiplication & division of whole numbers
- Round whole numbers & decimals to a predetermined place value
- Multiply & divide both fractions and decimals to solve problems
- Convert between any two number representations (fraction, decimal, percent) without using a calculator
- Interpret & use ratios to show the relative sizes of two quantities
- Understand proportions and use them to solve problems
- Write & solve one-step linear equations with one variable
- Read, write, compare, & solve whole-number notation problems

Prerequisite skills

Of the three prerequisites, two are mathematical and can be troublesome for some students- scale conversion and dimensional analysis. The third, reading for information, is a specialized skill that requires practice and support across all grade levels.

Standards

Numbers & Operations - Base Ten
- Perform operations with multi-digit whole numbers and with decimals to hundredths.

Numbers & Operations- Fractions:
- Apply and extend previous understandings of multiplication and division to multiply and divide fractions.

Measurement & Data:
- Convert like measurement units within a given measurement system.

Ratios & Proportional Relationships:
- Understand ratio concepts and use ratio reasoning to solve problems.
- Analyze proportional relationships and use them to solve real-world and mathematical problems.

The Number System:
- Compute fluently with multi-digit numbers and find common factors and multiples.
- Apply and extend previous understandings of operations with fractions to add, subtract, multiply and divide rational numbers.

Expressions & Equations:
- Work with radicals, integers and exponents.

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Teacher's guide

Time to complete

1 block period or 2 traditional (45-minute) periods

Teaching suggestions

The first 45-minute segment (Economy) might best be accomplished by pairing students and walking them through each of the five questions. The second 45-minute segment (Ecology) is tailor-made for group work, and time for these five problems could be expanded to accommodate presentations of the various solution strategies used.

Answer key: Economy

1. 17

2. 17, 59, 0.98

3. 27

4. 13, 11, 0.48

5. about 2:1

Answer key: Ecology

1. 10,000 kWh/year, 28,000 watt-hours/day

2. inaccurate

3. 2 hours

4. 133,333 workouts, about 7.6 years

5. 18 days