Re: electricity from a gym: quick calcs

Source: http://sci.tech−archive.net/Archive/sci.electronics.design/2007−09/msg02497.html

- *From*: ehsjr <ehsjr@xxxxxxxxxxxxxxx>
- *Date*: Thu, 13 Sep 2007 19:40:51 GMT

mrdarrett@xxxxxxxxx wrote:

> On Sep 13, 7:41 am, ehsjr <eh...@xxxxxxxxxxxxxxxx> wrote:
>
> > mrdarr...@xxxxxxxxx wrote:
> >
> > > I had a conversation with a co−worker about harnessing energy from
> > > folks dancing on a dance club, and from folks walking in a mall during
> > > the shopping season. I was skeptical, thinking the capital costs
> > > would outweigh any benefit, but decided to run the calcs just to be
> > > fair.
> >
> > > I was *sure* I'd posted similar calcs on sci.physics or sci.chem a few
> > > years ago, but can't find them. So, I re−derived them.
> >
> > > Let's say we have a gym with 100 pieces of equipment, with generators
> > > on each of them. And let's also say the gym is open 24 hours a day,
> > > fully packed at all times.
> >
> > > Let's say each person exercises at a rate of 100 W (pretty hard work),
> > > or 0.1 kW.

Let's say electricity costs $0.10/kW per hour. (More in the bay area,
less here in wintertime...)

So, each person generates $0.10/kW/hr x 0.1 kW, or one cent per hour.
(Much less than minimum wage, I might add.)

That's 24 cents/day/piece of equipment.

$0.24/day x 100 pieces of equipment = $24/day, or $8,760/year in
electricity back to the grid.

Now for the equipment costs. Let's say that each generator thingie
costs $100, including installation labor costs. $100 x 100 pieces of
equipment = $10,000.

Breakeven time is just over a year.

Key assumptions:
− gym is fully packed at all times. Not gonna happen.

− each generator thingie, plus grid−intertie−converter, breaks down to
$100/piece of exercise equipment. That's awfully generous. Probably
more like $1,000/piece of equipment is closer to the mark...

− 100% credit from the electric company for electricity. Probably in
Minnesota, but not here...

> Any thoughts, folks?
>
> Michael (I'm *not* an electrical engineer, by the way)
>
> > In a typical gym you wouldn't recover the energy needed
> > to light the place, let alone sell power back to the grid.
> >
> > Yep. 10 kW *maximum*, assuming 100 pieces of equipment. That already
> > is a lot. *Can* one pack more than 100 pieces of exercise equipment
> > into a gym?
> >
> > 24 Hour Fitness is downright empty at times... not always fully
> > packed, as my optimistic calcs assumed. If only 10% occupied, 1kW...
> > can that power the fluorescent lights...? It definitely won't keep
> > the indoor pool heated...

It's worse − *far* worse − than that. In a typical gym, most of
the equipment is idle. On top of that, most of the exercisers
generate power intermittently rather than continuously while they
are exercising, with a lot of idle time between exercise sets.

The energy the human puts into some repetitive motion machines
must be "given back" to move the mechanisms back to the initial condition. If it were all converted from
kinetic to electrical, the machine would not return to the initial condition for the next cycle.
Repetitive motion (push and relax) machines would yield a very low efficiency.

Even if on a stationary bicycle type generator where power is
provided 100% of the time, a typical human can produce and maintain about 75 watts, not 100, according to:
http://www.humboldt.edu/~ccat/pedalpower/hec/hpeg/index.html

So to produce and maintain 1KW, you would need 13 people producing
a bit above average on continuous effort machines, like a bike,
which is not found in the typical gym. But say it was.
If that's 10% of the equipment, it implies 117 other machines,
all of which occupy space, and all of that space needs to be
lighted. So, since we're into "what−if" territory assuming
13 bikes producing 75 watts each, how many square feet will all
the (130) machines occupy, and how many square feet can 12 4 foot
(80 watt, two tube) watt fluorescant fixtures illuminate, meeting
commercial building code requirements? I'm not going to do the
math, as I don't know how many square feet each machine needs
nor what commercial code requires − but I doubt that that the

fixtures can each provide enough illumination for 11 machines per fixture. And then there is the requirment for emergency lighting, lighting in the showers, bathrooms, reception area, battery charging (so you can turn the lights on when you enter the room and no one is generating at the moment, or so you can keep the lights on when the last person stops exercising) etc.

Ed
.