# UCSD TIES Triathlon Team
# Continuity Report Fall 2010

Client: UCSD Triathlon Team

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## Introduction

### Client

The UCSD Triathlon Team is trying to be a leader in sustainability. Among their goals is utilizing their training power output in order to be more environmentally neutral. For the long term the Triathlon Team would like to equip their entire team with power producing trainers (about 30 trainers) at an affordable cost. The Triathlon team worked with an ENG100A team during winter 2009. The ENG100A team proposed a DC motor and battery solution. Last quarter, during the client meeting, when the ability to return power back to the grid was proposed, the client determined that as a high priority feature, thus, the 100A report is no longer applicable. Another high priority feature is durability, as the athletes put on many miles(revolutions) on these trainers during their training. This quarter we are switching back to a battery charging trainer due to limitations imposed by returning power back to the grid. This also has possibilities for clients helping out third world countries, who rely on battery power for electricity.


### Abstract

As it is evident that our lives depend heavily on energy, we need to have options for obtaining it. This project focuses on obtaining energy from a person riding a bicycle. One person alone might not be able to generate the most significant amount of energy, but the idea for this project is that with a group of people like the Triathlon team, it would be possible to make a difference in the amount of energy that the school consumes. An average person can generate about 300 watts while riding thus producing about 100-150 watts of usable energy. Lance Armstrong can generate about 600 watts for a sustained amount of time, which is seen as the maximum amount of power produced by any one person. It is assumed that anyone on the Triathlon team can ride with more intensity than an average person thereby increasing the amount of obtainable energy.

**Contacts/meetings/outcomes**

Green Guru's: Members of the Triathlon team that are responsible for the team's environmental awareness. Changes every quarter but technically should be in contact with them every time there is a question.

Sante (Triathlon Team captain): sakotturi@gmail.com Main contact for the Triathlon team.

Tim Aray (Triathlon team member): Taray@ucsd.edu

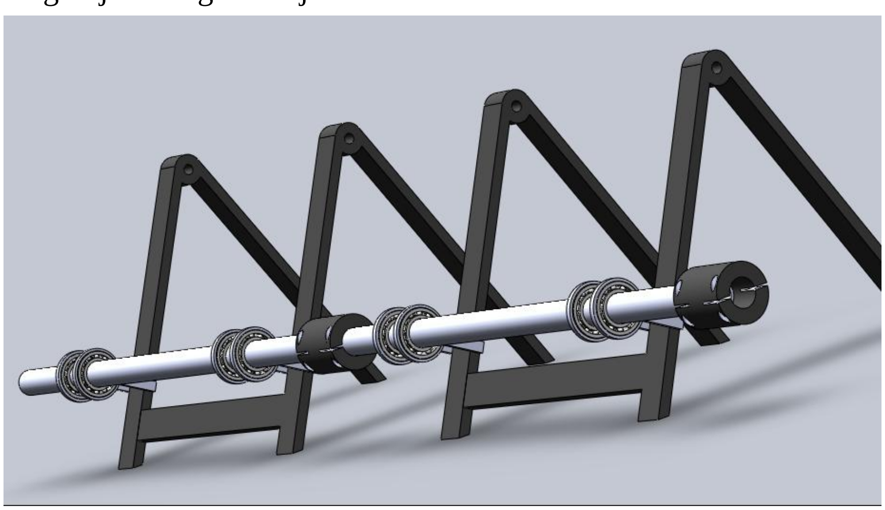
Anna Levitt (UCSD energy manager): Spoke to Ms. Levitt to see what her opinion was on placing custom outlets by the track. She liked the idea overall but was not comfortable with the idea of dealing with active loads to put in new outlets. Last meeting we had with her she said she would look more into whether this would be possible or not but has not contacted us since.

Jim Ruby (Manager of Fleet Services): jruby@ucsd.edu Mr. Ruby is in charge of the majority of golf carts and other transportation vehicles on campus. He also liked our ideas, and certainly saw it possible to charge golf carts with the only contingency being that we would have to connect the trainer to a delta Q charge controller (which they have) and then to the battery. But, he is not in charge of the golf carts that are around the track so he referred us to Lordes Tan Dawson 822 2999 who we did not get the chance to contact due to time constraints. Mr. Ruby told us that we should not have any trouble charging the batteries of the golf carts around the track yet they are different than those that he owns so we still need to check with Ms. Dawson.

## Design choices

### -Induction Motor

Several ideas were considered regarding various models for using an induction motor. We began by reviewing the pros and cons of the model from last quarter and determining what improvements should be made. Desiring to create the potential to have as many bikes as possible involved in the power-generating setup, we realized that the previous model plan would be expensive if we were to buy this type of induction motor for ten or twelve bikes. In addition, the motor required 200 watts from the wall power source to run. Thus, whenever a cyclist is not producing more than 200 watts, power would be used from the grid rather than created by the setup. After considering these things, we decided that the setup needed to involve either an induction motor system which could generate a very large amount of power to compensate for the power loss or a generator which never required power to be pulled from the grid. One exciting idea which we came up with involved the use of one huge induction motor which would be attached to a set of rods which would be attached in series across multiple bike trainers. A large group of triathlon team members would be able to simultaneously run the motor and create a considerably large amount of energy. This setup, known as “Mega-rod” (see image below) was eventually determined to be difficult to realistically use because of the heaviness of the induction motor which would need to be transported each week to the practice site and problems with putting the large amount of power produced into a standard socket at the track. While the ideas for induction motors were certainly interesting, they were all deemed to be inefficient in some way. As a result, we eventually turned our research direction towards alternative generators. If this design were to be considered for any future bicycle trainer designs, the most important part of the design is to have flexible couplers joining the trainers. This is because the ground is almost never level leading to jamming at the joint.



Mega-rod rendering. (2 Units hooked up together)

**-Alternator**

The team decided that a more affordable and realistic way to generate power would be to use an alternator. Alternators produce energy through electromagnetism. They consist of two main components the stator and the rotor. The stator is the static part inside the alternator which contains coils, usually copper coils. The rotor is a large magnet that spins inside the alternator. As the rotor spins, it causes current to flow in the stator coils. The alternator is laid out to produce AC power however automotive alternators are equipped with diode rectifiers that convert all the power into DC. Cost is also greatly reduced since alternators are more common and accessible allowing us to get one for every bicycle trainer if needed. The goal is to make a shaft for the alternator that will allow a bicycle or group of bicycles to turn it therefore producing power. Once a prototype is built and has been tested to work properly, we can begin on making many more of these things.

Other parts are also required in the alternator plan. The first of which is a battery of some sort. Our team looked into various batteries and we determined that what we need is some sort of large capacity deep-cycle battery which would be ideal for the frequent charging and discharging that we would be doing. The next required part is some sort of charge controller. If in the next quarters of the project the team has Electrical Engineering majors, this would be an ideal project for them. Either determining the appropriate specs for a charge controller purchase or even designing some sort of charge controller circuit. Models that we looked at can cost somewhere around $100, however, if we design our own we can definitely lower that cost as each trainer will need a charge controller. Also, designing our own circuitry would be ideal as that would later allow us to better monitor output and perhaps integrate some sort of power output display. In the future after a battery charging prototype is created, we can look into grid-tie inverters which can be used to return power to the grid. Since the Triathlon team only trains once a week, we can use a relatively cheap and low power grid-tie converter to slowly convert the stored energy into the appropriate AC current and return it to the grid. An ideal area for any mechanical engineers on the future team would be to work on mounting all the parts safely and securely.

**Future goals**

We realized that the way we used/stored the power generated would have a big impact, if not decide, the design requirements & specifications. Even though initially the Triathlon team (client) wanted to put power back into the grid, after we looked at the engineering feasibility of that & other options, & having spoken to the client, we recommend pursuing other options. We spent our quarter researching & meeting with outside resources to figure out what there “other options” might be. Hence our future goals for this project can be summarized into the following 3 options:

(i) Charge devices
(ii) Put power back into the grid
(iii) Store power in a high capacity battery

**(i) Charge devices**

We considered charging campus golf carts. These golf carts could also have a decal identifying it as running on “green energy”. However after meeting with a campus utilities representative, it became clear that logistical issues will first have to be worked out. We highly recommend speaking with them again to see how feasible this option is. Charging lecture podcast microphones was also a possible idea our team came up with. Lastly the power could also be used to charge the personal electronic devices of the Triathlon team.

**(ii) Power back into grid**

This option has been discussed in detail previously in our continuity report & also in previous continuity reports. It is important to review those sections to review the pros & cons of this option.

**(iii) Store power in high capacity battery**

A third, “hybrid” option would be to store the power in a high capacity battery such as the Duracell “Powerpack”. Then at a convenient time, the battery can be connected to a grid-tie inverter to discharge & put power back into the grid or charge devices such as the golf carts of the triathlon team’s electronic devices. One thing to consider is the potential high cost of such high capacity batteries. Also going down this path still requires decisions & designs to be made regarding the final “destination” of the power i.e. either to return it into the grid or charge devices.

**Cost Analysis**

Car Alternator: $30

The cost of the car alternator was low since we bought it from a junk yard. The lowest price for a new alternator is around $50 but it can go up to around $150. All the other parts were from last quarter, and these include the bike trainer and platform for the alternator. The cost for this set up is cheap compared to last quarter's set up, which had a $130 AC induction motor. Next quarter, we are considering connecting this to a grid tie inverter so we can put power back into the grid, and this would add an additional cost.

**Appendix A**: Alternator specs/pics

**Appendix B: Links/Sources**


http://www.econvergence.net/Merchant2/merchant.mv?Screen=PROD&Store_C...
http://en.wikipedia.org/wiki/Microcontroller
http://www.econvergence.net/electro.htm
http://www.los-gatos.ca.us/davidbu/pedgen.html
http://www.los-gatos.ca.us/davidbu/pedgen.html
http://www.alternative-energy-news.info/pedal-powered-electricity-gen...
http://www.ehow.com/how_5130413_generate-electricity-bicycle.html
http://michaelbluejay.com/electricity/bicyclepower.html
http://www.popsci.com/technology/article/2010-04/hotel-pays-guests-me...
http://www.popsci.com/science/article/2009-12/mits-copenhagen-wheel-m...
http://en.wikipedia.org/wiki/Cycling_power_meter
http://www.bikeradar.com/news/article/interbike-new-vector-power-mete...
http://www.pedalpowergenerator.com/how-to-use-a-power-meter.htm
http://www.powercostmonitor.com/p3982/power_cost_monitor.php