

**“Quantifying Energy Savings and  
Environmental Impact of a High Efficiency  
Pump Installation”**

Jack Adams, Principal Investigator

A Merrimack College Faculty Led Initiative project

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## Overview

In this project I proposed to fund the installation of a high efficiency pump and to measure the impact on energy usage. The intention was to support the agenda for Distinction Objective that reads: *"Promote energy efficiency and renewable energy, to mitigate our impact on the climate. Create more efficient, environmentally friendly, and socially equitable campus operations; reduce our carbon footprint; and bridge the dichotomy between campus operations and the curriculum."* A main challenge in any potential energy efficiency installation is: is this worth our investment? What will the Return on Investment be? Can we PROVE that the investment was worthwhile?

This project, with its emphasis on before and after measurement, provides a great opportunity to quantify energy and cost savings, thus creating a baseline of solid evidence upon which to base further decision making. agenda

## Proposed Deliverables

1. Working closely and based on the approval of physical plant, determine the best pump from reliability and energy savings standpoint, as well as initial cost.
2. Have the pump installed, along with monitoring equipment. The equipment needed for this is low cost and available in the EE department. Students taking the course "Energy Generation, Transmission, and Technology" will be involved in the monitoring during Spring 2013.
3. Determine the energy savings, cost savings, and environmental impact of this installation.

## Project results

### Deliverable 1: Pump selection and funding

In collaboration with Randy Sideman, chief plumber for the college, and representatives of Urell, Inc. of Watertown we determined that a Grundfos pump geared to the site requirements would fit the bill nicely. The initial quote was for around \$3,000, and came in at \$3,200. Physical Plant had been willing to cover installation, however this turned out to be far beyond anyone's expectations: the first quote to install was \$8,000 (!), and a more competitive bid did come in at \$3,800. At this point the difference between the funding provided by the grant (\$2,500) and the total installed cost (\$7,000) was more than Physical Plant could manage, with funding being tight.

The author proposed to the Green Council to provide some of the funding, so that we could present to Physical Plant a more palatable sum. All three Green Council leaders (Maria Serrao, also Autumn Linteau, and the author) agreed this would be a good use for some of the sustainability funds. What was finally worked out, after much discussion, was the following:

Provost's Innovation Fund	\$2,500	(as per the proposal)
Sustainability Fund	\$3,000	
Physical Plant	\$1,500	
<b>Total</b>	<b>\$7,000</b>	

## **Deliverable 2: Installation of pump and monitoring equipment**

The determination of a funding solution took a while to unfold, and the PO was not submitted to Urell until March or so of this year, 2013. Due to a factory backlog, it took a good while (1.5 months or so) for the product to arrive. The initial installation took place early in June. Due to an installation snafu, it was June 27 before the pump was up and running. The new pump is shown below.



The new Grundfos unit: the chromed area is the location of the actual pump, and the gray box above the chromed area is an integral part of the unit, and holds the controls. The black piping mates the existing piping to the Grundfos unit (to the left is hot water entering the pump, to the right and then looping behind is the exiting hot water). The control unit senses if more or less water pressure is needed, and adjusts the RPMs (speed) of the pump motor to match the needed requirements.

For comparison the OLD pump, identical to the one replaced with a Grundfos unit, is

shown below. There have to be two units for redundancy – in case one is not operational. The pump is housed in the green enclosure towards the front. Behind that, towards the back, is a gold enclosure: that contains the variable speed drive – when operating correctly this “drive” unit slows the pump down when demand is low, and speeds it up when demand is high. Just visible to the top left is a corner of the control unit housing.



Shown below is the control unit for the OLD pump (white enclosure in the forefront). Note the control unit the drive unit and the pump itself (green enclosure) are separate. The drive unit failed within a couple of years of installation and was repaired for about \$4,000. When it failed again a couple of years later, this variable drive feature was removed from service, and the pump was placed in “bypass” mode – meaning that it was full on, every hour of every day of the year.



The initial intention of the author was to install customized monitoring equipment: however I was not aware that quite advanced equipment, with great data logging capability, is incorporated into the control unit as part of the system. I still intend to work with students this coming fall to put secondary monitoring equipment at the location. This portion of the intended work (involving students in measurement) could not happen during the present project period as due to the funding challenges, delivery delays, and installation delays the pump was not up and running until well after the conclusion of the semester. Even so, significant preliminary curricular work was carried out.

### **Deliverable 3: Determine the energy savings, cost savings, and environmental impact**

Although the pump has only been operational for a couple of weeks as of this writing, there is already great, if preliminary, data available. The key data:

#### **Average power consumption**

Old unit: 6,600 watts (data taken over a month).

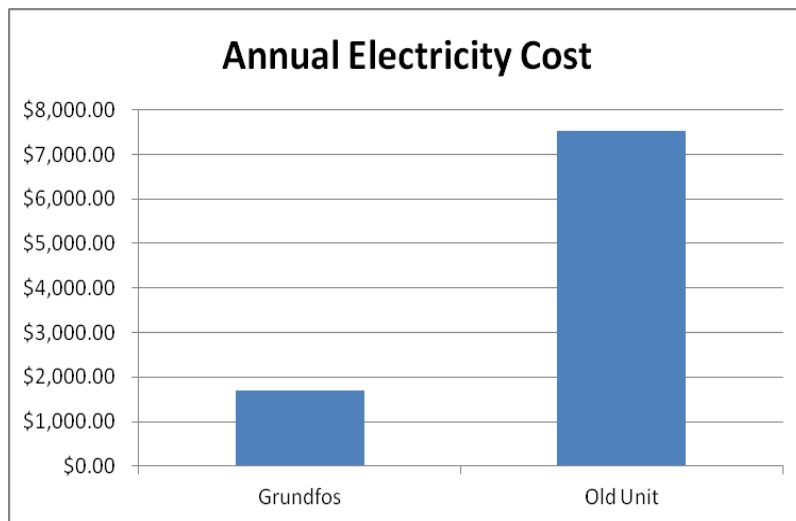
New Grundfos unit: 789 watts (about 10 day of data):

Annual energy usage

Old unit: 57,816 kW-h per year

New unit: 13,140 kW-h per year. (estimated)

Cost and cost savings can be calculated based on an estimate of 0.13\$/kW-h.



**Simple payback time:** \$7,000 (total cost) / \$5,800/year (savings) = **1.2 years**. This is equivalent to about an 83% return on investment.

**Environmental impact:** assuming that coal was used to generate the electricity to run this pump, **roughly 100,000 pounds of CO<sub>2</sub> emissions are avoided annually by the installation of this pump.** This is an excellent example of how cost savings considerations and environmental considerations can work together, rather than at odds as is often the misconception.

## **Project take homes**

**Community effort** This project was a community effort, involving faculty, staff, a student, and administration. The results are very exciting to the author – cost and environmental considerations CAN go hand in hand, and the data prove it. This lays the groundwork for much greater student involvement, and curricular impact, going forward.

**Justifying further investment in energy and cost reduction** There are many more pumps like the one addressed in this project: perhaps 8 or so in the same size range, then many in smaller size ranges which all would have similar paybacks. It is very possible that National Grid would be interested in a project to replace the old, extremely inefficient pumps – in fact the variable drive units like that shown earlier in this report were funded in part by National Grid. We (Randy, I and the Urell rep) are gathering an inventory, and one “to do” after the data are gathered will be to (going through the proper channels) approach National Grid. Even without National Grid, potential annual cost savings could be perhaps \$75,000, with a 1.2 year payback. If NG could fund 50%, then the payback would be less than one year:

**Green fund** The author has been very interested in establishing a “Green Fund”. The basic idea is as follows: seed a fund with some modest amount of capital. Let’s say the \$7,000 used for this project. Reload the fund out of savings from this first project, or even a portion of the savings. Then, when the fund is “reloaded” use it to fund further cost savings initiatives. It is very plausible that by the end of 10 years, 3 or more “projects” could have been funded by the initial \$7,000, multiplying the “power” of the dollars used to seed the fund.

## **Acknowledgements**

Thanks to Provost Modica-Napolitano and the selection committee for choosing to fund this work. The \$\$ will have been returned to the college via cost savings within 1.2 years ☺

Thanks to Randy Sideman for much work in making this happen and to Jimmy Finn for interest and resources in making this work.

Thanks to Maria Serrao for her strong interest in this work, and for helping determine how to make the \$\$ work. Thanks here as well to Autumn Lintean, student sustainability leader.

Thanks to Dan Squelia of Urell, for knocking on every door at Merrimack until finally someone (the author) answered with interest.

Thanks to my wife Diane for always believing in me and sharing my excitement and passion for positively impacting the environment.