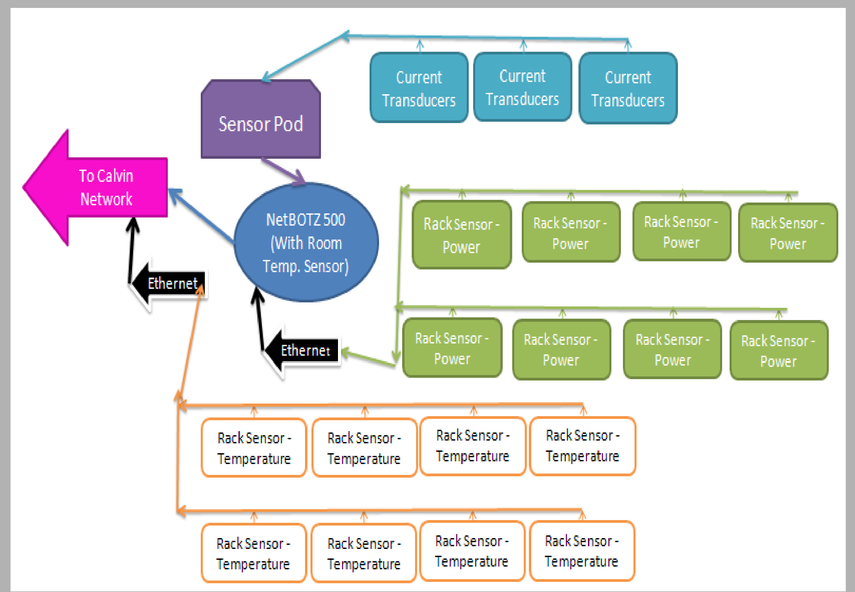
Calvin Redundant Data Center

Engineering 333 Class – Spring 2010

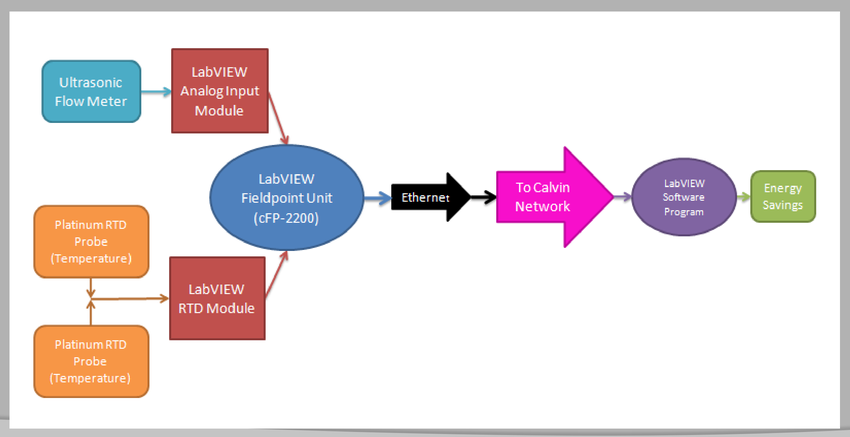
Instrumentation

The new redundant data center requires that Network Operations Center personnel are able to monitor certain conditions within the data center for the safety of the server equipment. Server equipment will fail if it gets too hot or if the surrounding environment becomes too humid, therefore the baseline instrumentation design must monitor both temperature and humidity in the data center. The system must also be capable of remotely alerting NOC personnel when there is a problem.

This is done by setting up a series of sensors in the data center to determine the energy flow. The information flow is shown below.



In order to justify funding from the Calvin Energy Recovery Fund, measurements around the pool heat exchanger need to be added. LabVIEW was used for these sensors so that the energy savings of the system could be tracked. The information flow from these sensors is shown below.



Financial

The Energy Information Administration (EIA), part of the Department of Energy, was used to estimate the future price of electricity over the next 20 years using low, average, and high projections, shown in Figure 1.

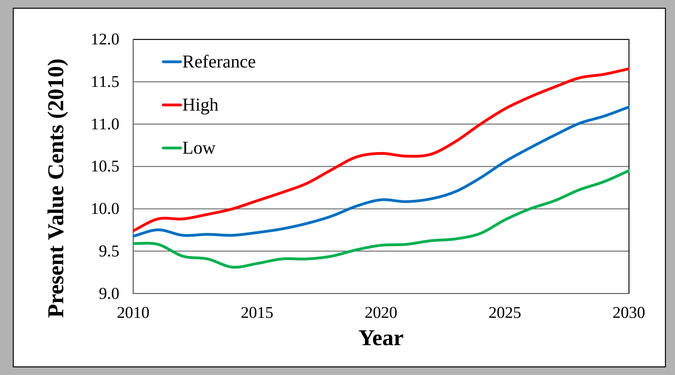


Figure 1. Future Electricity Price Projections

The EIA was also used to determine the price of natural gas over the next 20 years. The EIA projections were adjusted to the price Calvin College currently pays for natural gas. The EIA projection and the lower Calvin College projection are shown in Figure 2.

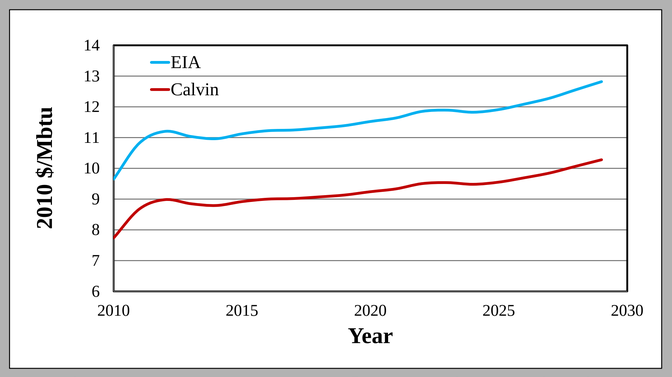


Figure 2. Future Natural Gas Price Projections

The total 20 year cost for each component is shown in Figure 3. The total cost difference between the two scenarios is small because energy prices dominate over capital equipment costs.

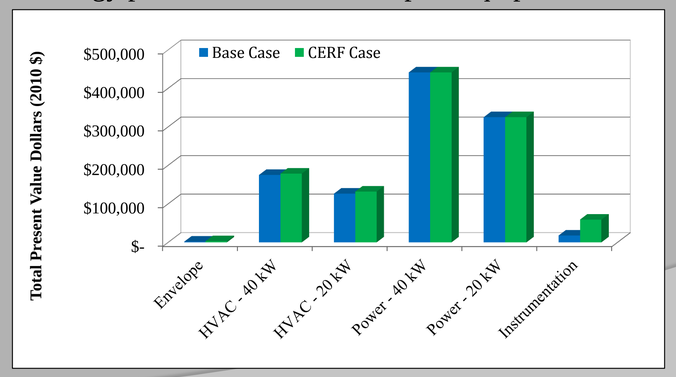


Figure 3. Cost Comparison over 20 years

A CERF investment of $10,500 to cover the additional cost of the energy efficient pool loop and instrumentation results in energy savings totaling $155,000 to $207,500 over 20 years (depending on the energy usage of the data center), shown in Figure 4.

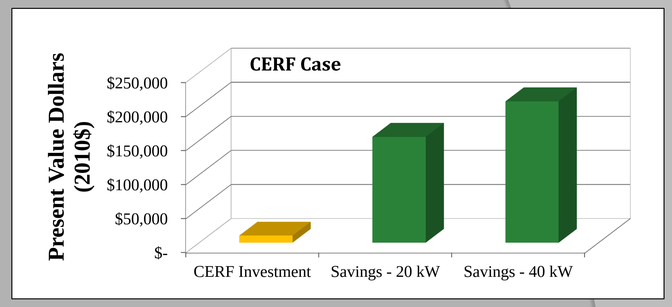


Figure 4. CERF Initial Investment and Resulting Savings

The energy savings from the project will be routed back into CERF to repay the initial investment and grow the fund. This project pays for itself in two years after which it will continue to contribute to CERF for 5 years, roughly doubling CERF's size, shown in Figure 5.

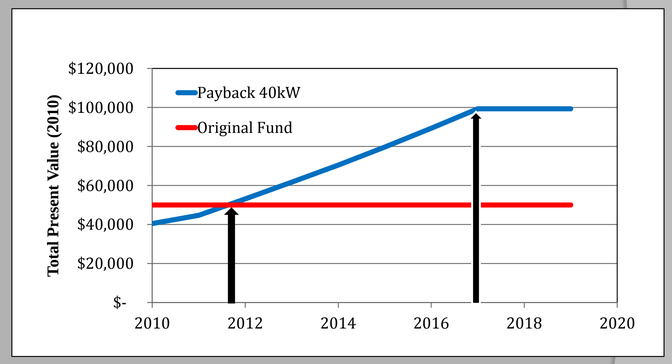


Figure 5. Project Effect on CERF Balance

Efficiency was calculated using the equation:

$$\frac{\textit{Energy to Server + Energy to Pool}}{\textit{Energy to Server + Energy to UPS + Energy to HVAC}}$$

The class met its goal of increasing efficiency by 30%. The CERF case is more than twice as efficient as the old data center and 92% more efficient than the base case, shown in Figure 6.

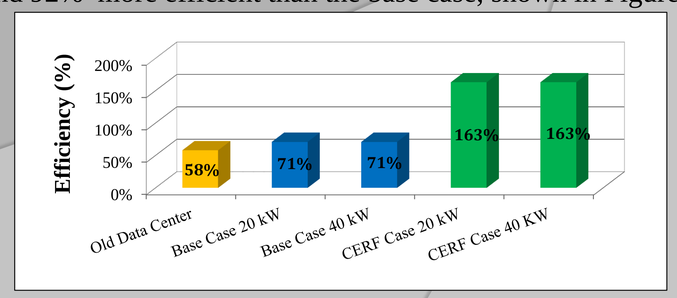


Figure 6. Efficiency Results

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