ZF TEAM #39

Energy Reduction

Jesus Davalos, Robert Ferry, Austin Fortman, Ruben Rocha ; Mentor: ***Ralph Munguia ; Sponsor: John***

PURDUE UNIVERSITY
Polytechnic Institute

OBJECTIVE

The objective of this capstone project is to identify energy inefficiencies throughout the plant in order to maintain and enhance operational efficiency. The goal is to improve ZF's competitiveness in the driveline and chassis technology industry by reducing energy costs and enhancing sustainability. Through this project, energy consumption will be optimized, contributing to both cost savings and a more sustainable operational model.

CUSTOMER PROBLEM AND BACKGROUND

Energy Efficiency Challenges at ZF Lafayette
- Excessive energy consumption across daily operations
- Continuous operation of: Heating, Cooling, and Lighting
- Inefficient system usage:
- Equipment runs beyond actual demand
- Leads to substantial energy waste
- Consequences:
- Elevated operating costs
- Increased greenhouse gas emissions
- Higher carbon footprint
- Accelerated equipment wear and tear
- Reduced machinery lifespan

Opportunities for Improvement
- Implement smarter controls to match energy use with actual demand
- Upgrade to energy-efficient systems for:
- Heating, Cooling, and Lighting

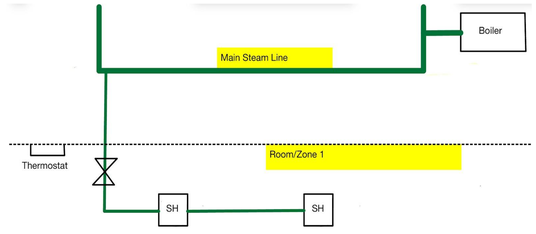
Benefits:
- Reduced energy consumption
- Lower operational costs
- Longer equipment lifespan
- Improved sustainability performance
- Reduced environmental impact

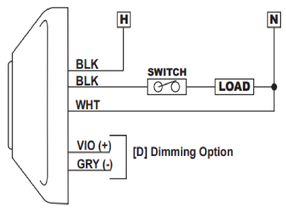
CONCEPTS AND EXPERIMENTATION

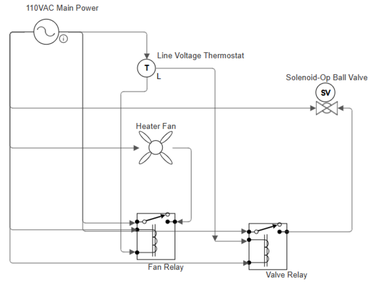
- **What is a PIR Sensor?**
- PIR stands for *Passive Infrared* sensor
- It detects movement by sensing heat, especially from people
- **How It Works**
- All living things give off heat as infrared radiation (invisible to the human eye)
- PIR sensors can "see" this heat
- The sensor has two parts that measure infrared energy
- When someone moves across the sensor's field of view, the amount of heat changes
- This change tells the sensor that something has moved
- The sensor sends a signal to turn on a light
- **Common Uses**
- Found in homes, offices, and buildings
- Used in lights, alarms, and security systems
- Help save energy by turning lights on when someone is present
- Turn lights off when the room is empty
- **Advantages**
- Simple to use
- Low-cost
- Uses very little power
- **Limitations**
- Only detects warm, moving objects
- May not detect slow or cold movement

REQUIREMENTS AND FINAL DESIGN

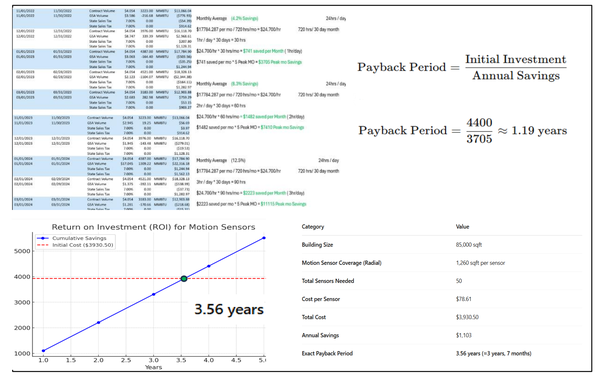
- Achieve measurable energy savings through equipment upgrades, process optimization, or efficiency improvements.
- Ensure the solution achieves a payback period of less than 5 years.
- Calculate the return on investment and ensure it aligns with the company's financial goals.
- Identify equipment, materials, and labor costs associated with the solution.
- Explore available rebates, tax credits, or incentives for energy-efficient solutions.
- Record baseline energy usage before implementing the solution to accurately assess improvements.







TESTING RESULTS



$$\text{Payback Period} = \frac{\text{Initial Investment}}{\text{Annual Savings}}$$

$$\text{Payback Period} = \frac{4400}{3705} \approx 1.19 \text{ years}$$

CONCLUSION AND RECOMMENDATIONS

Electric Actuated Ball Valves
- In the design calculations, significant savings are demonstrated through energy reduction across different time intervals. These savings increase with reduced boiler load over one hour, two hours, and three hours per day, translating to monthly savings ranging from $741 to $2223. During the peak five-month period, savings range from $3705 to $11,115, which align with the sponsors' expectations. However, due to current circumstances, it is not feasible to move forward with this plan at the moment.

Installation of Motion Sensors
- For the Lighting Division Building, the installation of motion sensors results in a minimum 12.5% reduction in lighting use, cutting down from 16 hours to 14 hours per day. This leads to yearly energy savings of $1103 and an average reduction of 10,000 kWh annually. Based on the calculations, these measures provide substantial savings and offer a viable option for future consideration.