

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



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

ZF TEAM #39

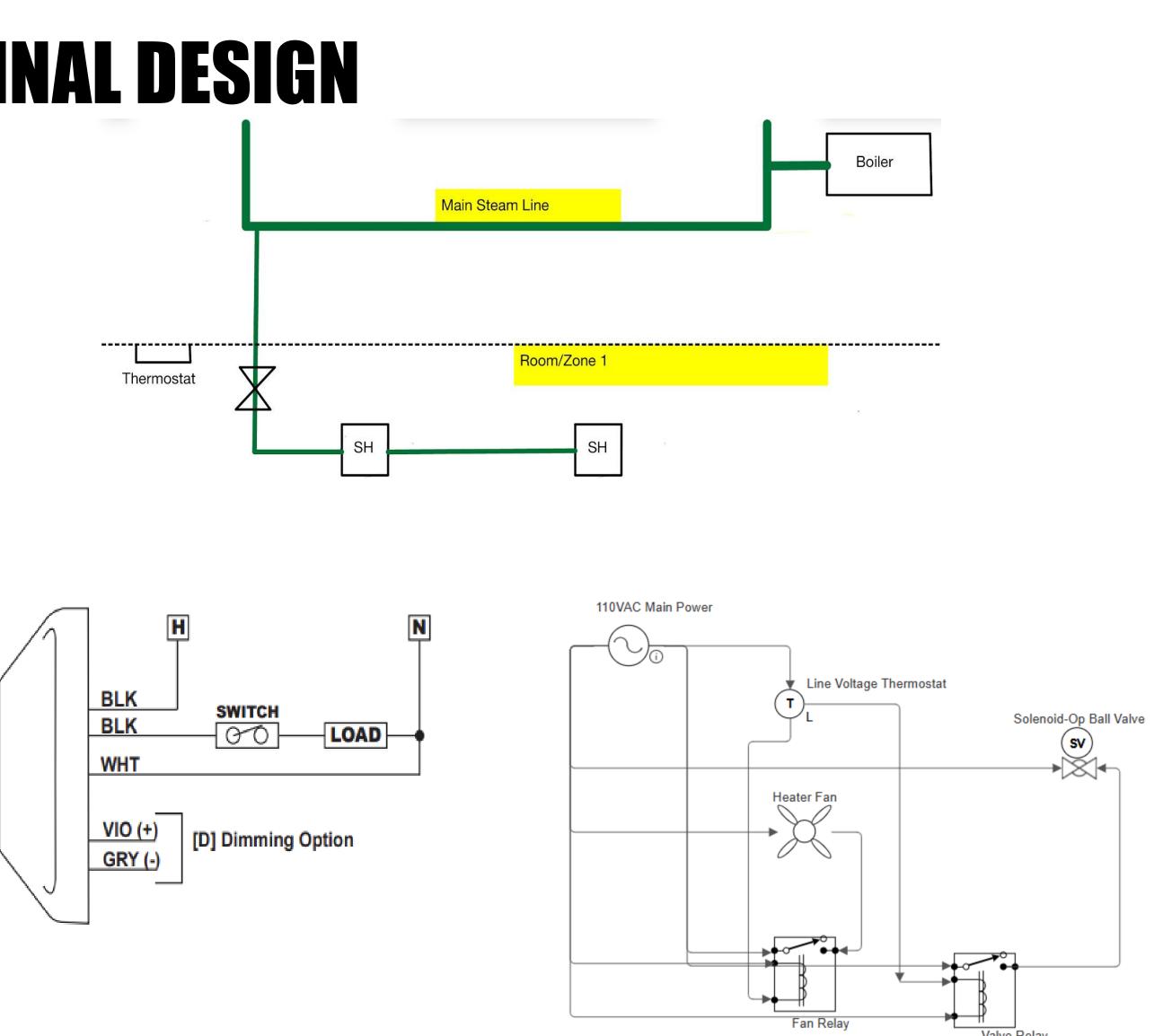
Energy Reduction

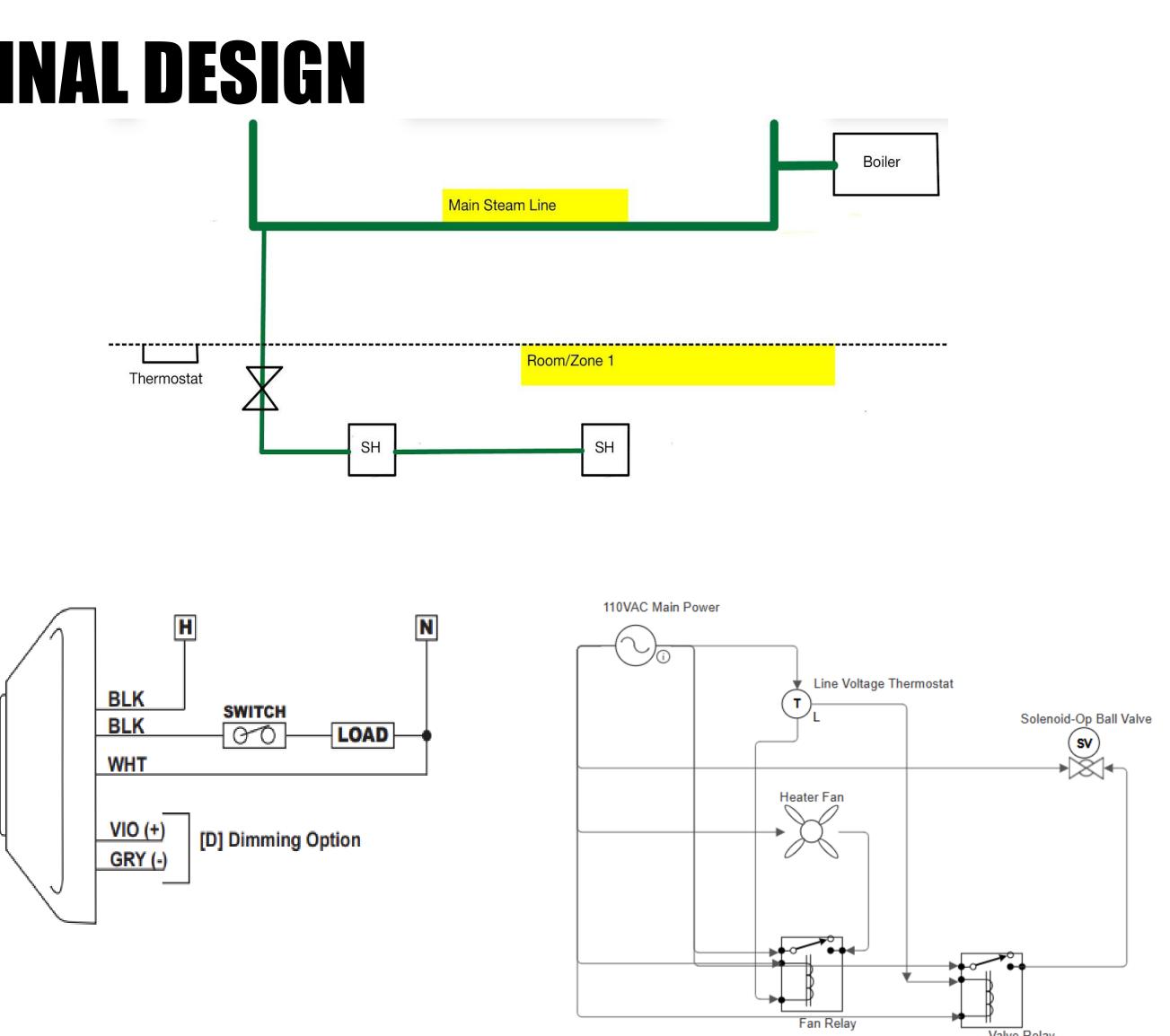
CONCEPTS AND EXPERIMENTATION

- 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

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 energyefficient solutions.
- Record baseline energy usage before implementing the solution to accurately assess improvements.









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

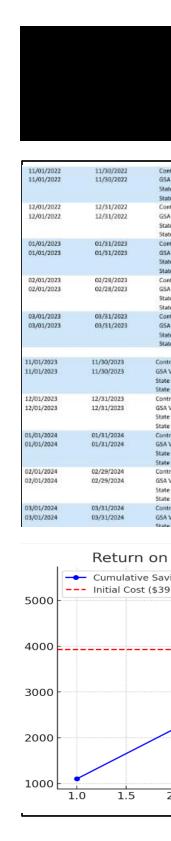
Low-cost

• Uses very little power

• Limitations

Only detects warm, moving objects

May not detect slow or cold movement





• 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.



Polytechnic Institute



TESTING RESULTS

ontract Volume		3223.00 MMBTU -216.68 MMBTU				
tate Sales Tax	7.00%		(\$54.39)	Monthly Average (4,2% Savings)	24hrs / day	
tate Sales Tax ontract Volume	7.00%	0.00 3976.00 MMBTU	\$914.62 \$16,118.70	\$17784.287 per mo / 720 hrs/mo = \$24.700/hr	720 hrs/ 30 day month	
SA Volume tate Sales Tax		339.39 MM8TU		1hr / day * 30 days = 30 hrs		
tate Sales Tex	7.00%	0.00	\$1,128.31			
ontract Volume		4387.00 MMBTU -164.40 MMBTU		\$24.700/hr * 30 hrs/mo = \$741 saved per Month (1hr/day)	Turit in 1 Turner store and
tate Sales Tax	7.00%	2.03.0388	(\$35.25)	\$741 saved per mo * 5 Peak MO = \$3705 Peak mo	Savings	Deschools Design Initial Investment
tate Sales Tax ontract Volume		4521.00 MMBTU				Payback Period = $\frac{\text{Initial Investment}}{\text{A payback Service as}}$
SA Volume tate Sales Tax	\$2.123 7.00%	-1104.07 MMBTU 0.00	(\$2,344.38) (\$164.11)	A CARL REPORT OF MELTING	011-11-	Annual Savings
tate Sales Tax	7.00%	0.00	\$1,282.97	Monthly Average (8.3% Savings)	24hrs / day	
ontract Volume SA Volume		3183.00 MMBTU 282.98 MMBTU	\$12,903.88	\$17784.287 per mo / 720 hrs/mo = \$24.700/hr	720 hrs/ 30 day month	
tate Sales Tax tate Sales Tax	7.00%		\$53.15 \$903.27	2hr / day * 30 days = 60 hrs		
ntract Volume	\$4.054			\$24.700/hr * 60 hrs/mo = \$1482 saved per Month	(2hr/day)	
A Volume	\$2.945	19.25 MMBTU	\$56.69	the second second second second		$ ext{Payback Period} = rac{4400}{3705} pprox 1.19 ext{ years}$
ite Sales Tax ite Sales Tax	7.00%	0.00	\$3.97 5914.62	\$1482 saved per mo * 5 Peak MO = \$7410 Peak m	io Savinga	Payback Period = $$ ≈ 1.19 years
ntract Volume	\$4.054	3976.00 MMBTU	\$16,118.70			3705
A Volume ite Sales Tax	\$1.945 7.00%	-143.48 MMBTU 0.00	(\$279.01) (\$19.53)			
ite Sales Tax ntract Volume	7.00%	0.00 4387.00 MMBTU	\$1,128.31	14	041-044	
A Volume	\$17.045	1309.22 MMBTU	\$22,316.18	Monthly Average (12.5%)	24hrs / day	
ate Sales Tax ate Sales Tax	7.00%	0.00	\$1,244.94 \$1,562.13	\$17784.287 per mo / 720 hrs/mo = \$24.700/hr	720 hrs/ 30 day month	
ntract Volume A Volume		4521.00 MMBTU -392.11 MMBTU		3hr / day * 30 days = 90 hrs		
ite Sales Tax	7.00%	0.00	(\$37.73)	\$24.700/hr * 90 hrs/mo = \$2223 seved per Month	(2br/dau)	
ate Sales Tax ntract Volume	7.00% \$4.054	0.00 3183.00 MMBTU	\$1,282.97 \$12,903.88			
A Volume ate Sales Tay	\$1.281	-170.66 MMBTU	(\$218.68)	\$2223 saved per mo * 5 Peak MO = \$11115 Peak r	mo Savings	
n Inves	stme	ent (ROI)	for N	lotion Sensors	Category	Value
vings						
930.50)					Building Size	85,000 sqft
					Motion Sensor Cove	rage (Radial) 1,260 sqft per sensor
					Total Sensors Neede	d 50
				2 5 6	Cost per Sensor	\$78.61
				3.56 years	Total Cost	\$3,930.50
	-				Annual Savings	\$1,103
2.0	2.5	3.0 Years	3.5	4.0 4.5 5.1	Annual Savings Exact Payback Perioc	

CONCLUSION AND RECOMMENDATIONS

Electric Actuated Ball Valves