Problem: The overhead door are left open much longer than necessary. This results in energy consumption costs drastically increasing due to the draw from the heaters.

Solution:
- Magnetic Proximity Sensor (MPS)
  - The MPS would detect the presence of transport vehicles and open the doors allowing them to pass. The doors would close after the vehicles had passed through and left the range of the sensor.

  - Cost: $11,140
  - Annual Savings: $2,938.00
  - Return on Investment: 4 Months

- Temperature Control Valve (TCV)
  - The TCV would allow for the maximum savings. The MPS would allow for automated door opening and closing.

  - Cost: Minimal. Less than $1000.

- Combination Temperature Control Valve and Magnetic Proximity Door System

  - Cost: Low. Less than $3000.

  - Return on Investment: 2 Months

  - Annual Savings: $24,750

Results:
1. Surveillance conducted on employee behavior while operating the doors. Concluded that employees, with reminders could keep the doors at their minimum cycle time, reducing cost with little investment.
2. Determined that the bulk of the costs associated with the project was not the heaters, but due to the boilers used to provide steam to the heaters.
3. Presentured four different solutions to assist with enhancing the efficiency of the system.
   - Driver Education and Door Modification – Reminding the employees to keep the doors closed.
   - Automated Magnetic Proximity Door System – Doors open and close as needed.
   - Combination Temperature Control Valve and Magnetic Proximity Door System

The greatest concern centers on the drastic difference in energy required for the overhead door heaters to perform adequately versus how much energy the boilers are producing. The difference between the given output and the ideal output indicates that considerable quantities of energy and money are wasted.

**Problem:**
- The overhead doors are used when transporting materials between Facility 1 and Facility 2.
  - Door 1 will open, activating heater 1. Door 2 will then open, activating heater 2. Both heaters remain on until the employee is finished transporting the material.

  - The excess door open time causes the heater to remain active and in turn draws more energy from the boiler.

  - The doors could ideally cycle (open and then close) in under 1 minute.

  - Current estimates put the average door cycle time to approximately 3.5 minutes.

- Overhead Door Cycle Time and Heater Activation:
  - The overhead doors are opened when transporting materials between Facility 1 and Facility 2.

  - Door 1 will open, activating heater 1. Door 2 will then open, activating heater 2. Both heaters remain on until the door is closed.

  - Due to the doors remaining open considerably longer than necessary, the heaters consume an exorbitant amount of energy in comparison with the minimum amount they would need.

- **Combination Solutions:**
  - Magnetic Proximity Sensor (MPS)
  - Temperature Control Valve (TCV)

  - The MPS would detect the presence of transport vehicles and open the doors allowing them to pass. The doors would close after the vehicles had passed through and left the range of the sensor.

  - Cost: $1,114.00
  - Annual Savings: $2,938.00
  - Return on Investment: 4 Months

  - Cost: $5,000.

- **Process Overview:**
  - Two steam heaters are used to buffer the colder air entering the facility when the door(s) are opened.
  - The heaters have a total input Btu of 1,034,400 while the boilers supplying the steam have a total input Btu of 17,250,000.

  - The boilers currently consume 16,000 dekatherm annually, of which 12,000 dekatherm is used for heating.

  - The heaters only require 637 dekatherm, or 6% of the total heat output of the boilers to perform at their current level.

- **Problem:**
  - The boilers used to provide steam for the heaters are substantially larger than necessary. Therefore, exceptionally high inefficiencies take place due to the over-supply of steam to the heaters compared to what is actually used.

- **Solution:**
  - Installing a Temperature Control Valve capable of limiting the steam used by the heater. The steam used by the heater will be regulated by the outdoor temperature.

  - Lower levels of steam will be supplied to the heater under warmer temperatures and as the temperatures decrease over the winter, more steam will be supplied.

  - Cost: Low. Less than $3000.

  - Return on Investment: 2 Months

  - Annual Savings: $24,750

The chart below details how the overhead door heaters compare to the boilers in terms of energy consumption and cost.

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**Overhead Door Heater Energy Consumption Reduction**

**A Project In Mechanical and Social Problem Solving**

Ryan Kamm, Research Assistant, Western Michigan University

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The difference in cost between what the overhead door heaters would consume versus what the boilers produce.

**Thank You!**

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