AEE N OH Chapter

3/26/23

# Using Infrared Technology to Identify Energy Saving Opportunities

Energy Basics
James Park

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# Course Description

SC Tri Association of Facility Managers

## Using Infrared Technology to Define Energy saving Opportunities

***Jim Park, CIEA, CIT, BPI, Energy Conservation Specialist, I-Star Energy Solutions***

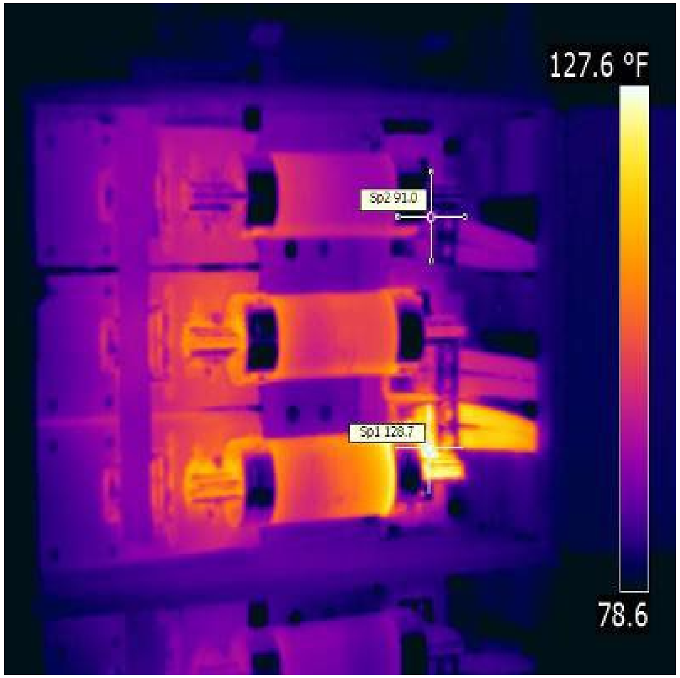
All facilities have tiny energy wasters so small and insignificant they are never seen. Some are obvious to the analyst but appear normal to the occupants and even the facility managers. Until a specialist does the analysis and attaches the monetary value nothing ever gets done. Even then, other things have priority. Many facilities pay good money for infrared cameras for a fun tool (even though they won't admit it), for real electrical purposes but often use it without proper training. Once they are trained and walk around, they can find lots of other energy saving opportunities. Once they see the opportunities, they might get the impression there might be value in the analysis. I hope this presentation will open eyes to the possibilities for infrared analysis in facilities and open the eyes of Facility Managers to opportunities for meeting energy goals.

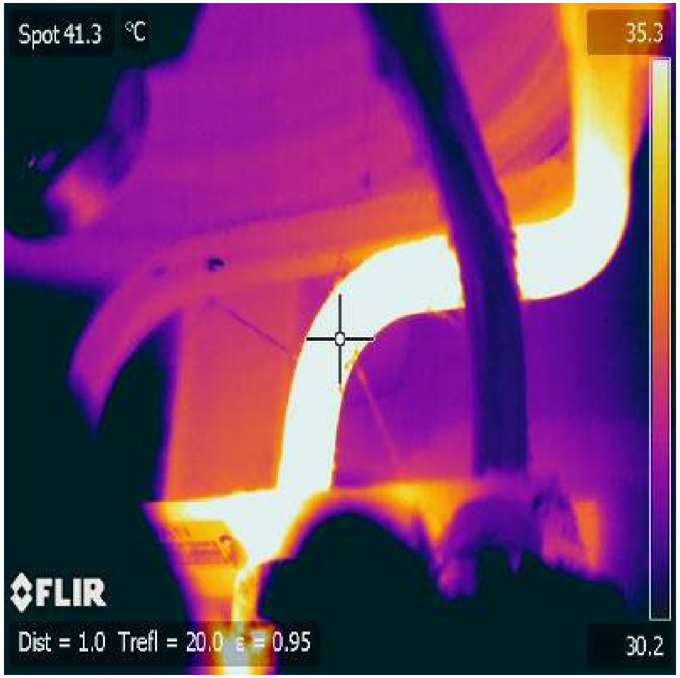
# Learning Objectives

Attendees will learn:

1. Learn what infrared measures and how to make use of the measurements
2. Learn the importance of infrared training to properly and effectively use the technology
3. How to find other uses for infrared analysis
4. Why infrared is an effective tool to find energy saving opportunities and how to act on them

# *Electrical surveys identify areas of concern like loose connections and overheated components due to increased resistance*

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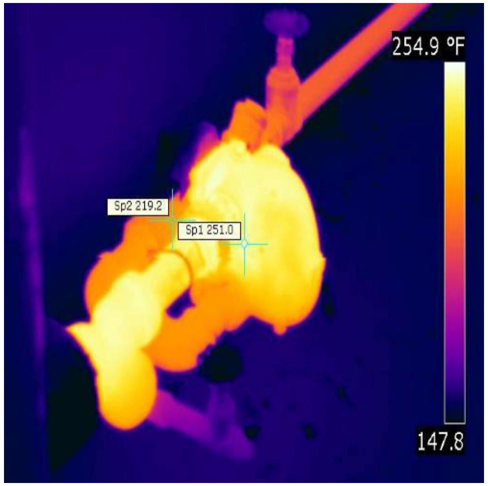
# *Steam trap assembly, close to the floor, in a dark area*

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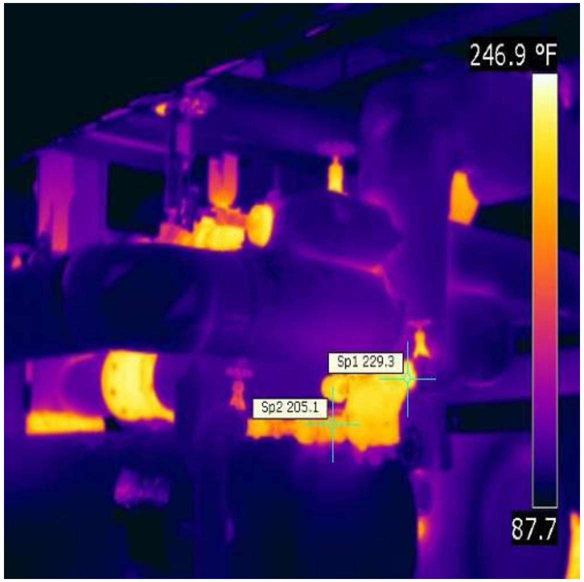
# Out of sight out of mind.

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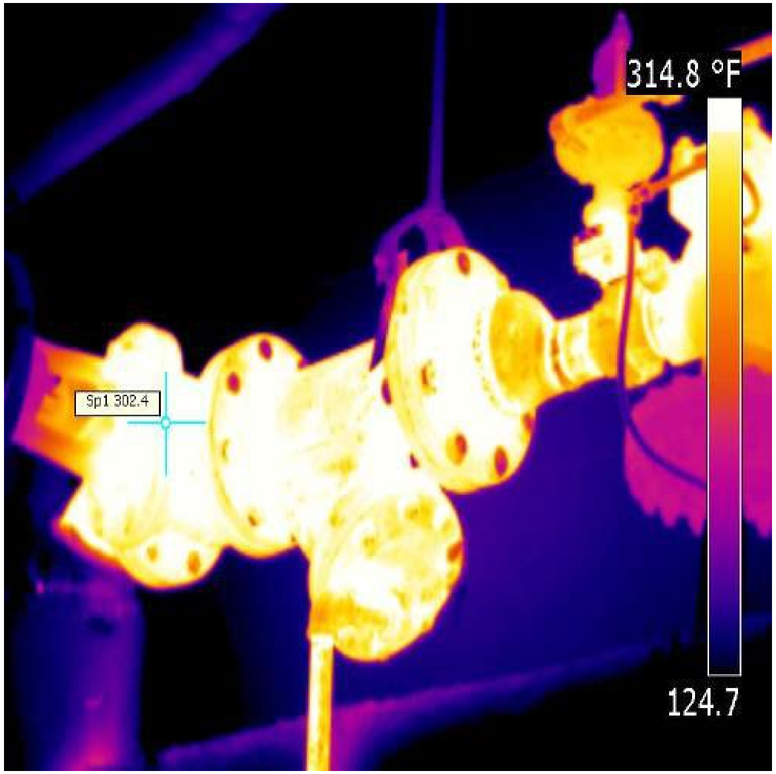
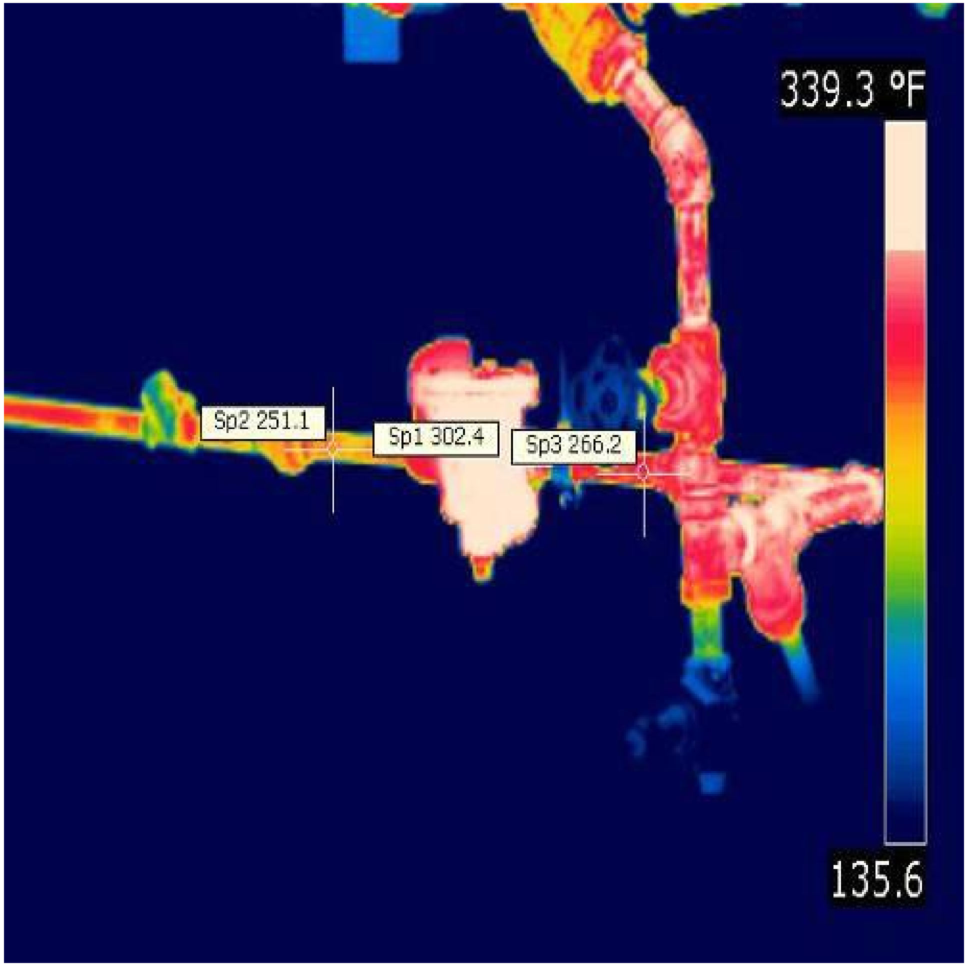
# *Typical Valve/Strainer assemblies*
# *The addition of Any Insulation will result in a quick payback*

# FAILED STEAM TRAP

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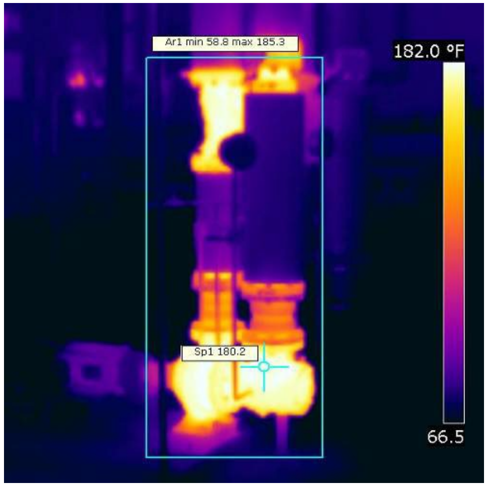
# *HYDRONIC HEATING PUMPS*

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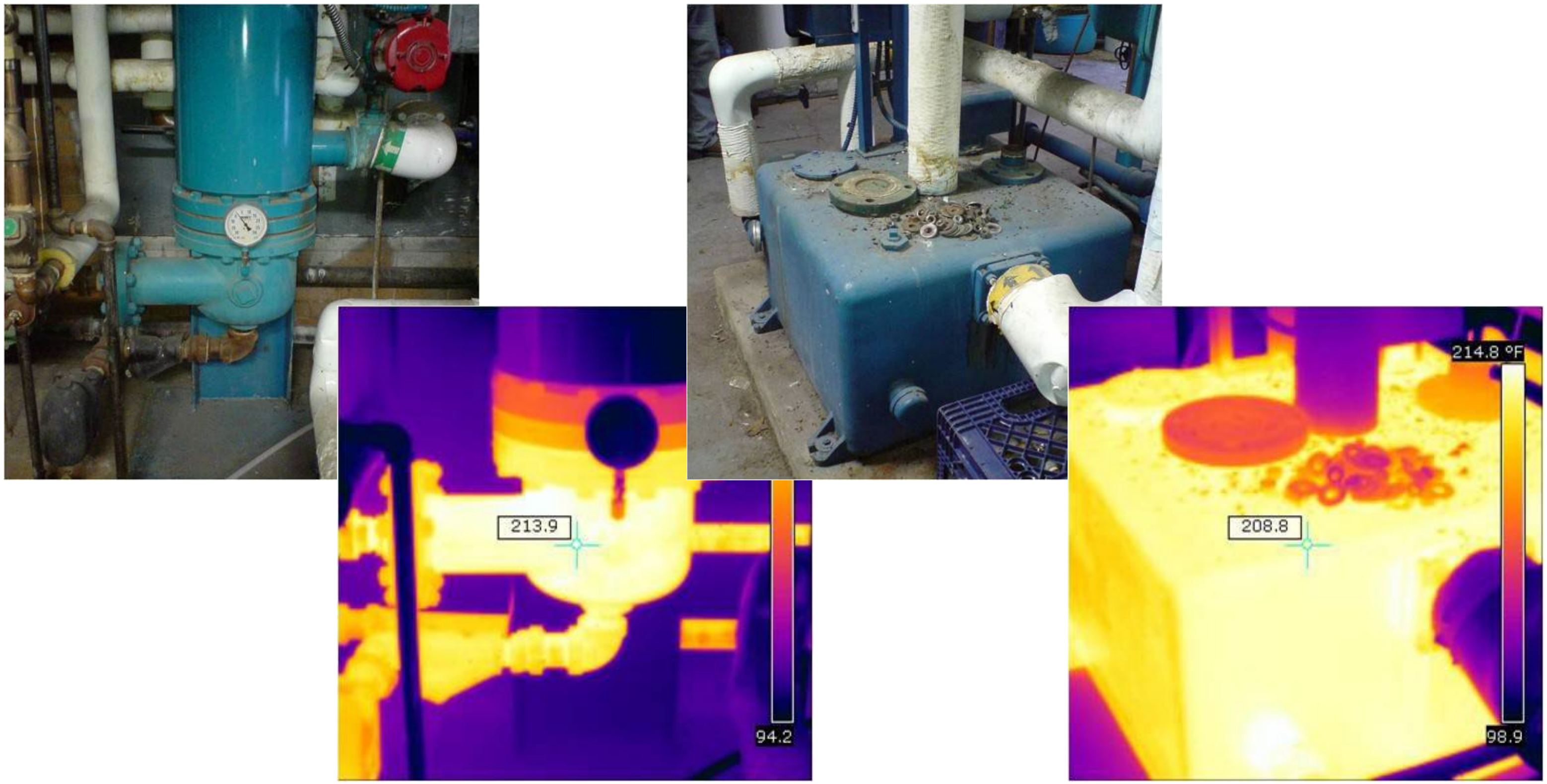
# *The condensate receiver tanks and condensate pre-heaters*

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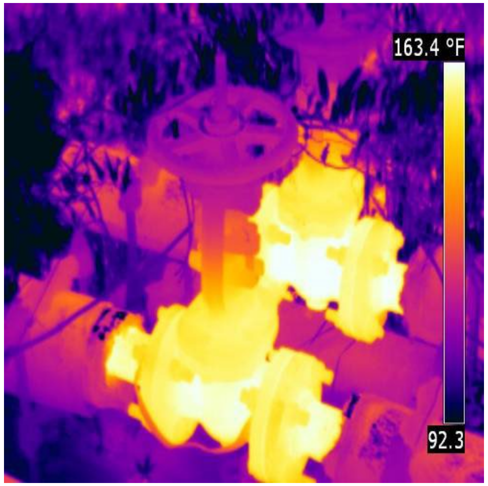
# *Exterior piping and valves are often neglected*

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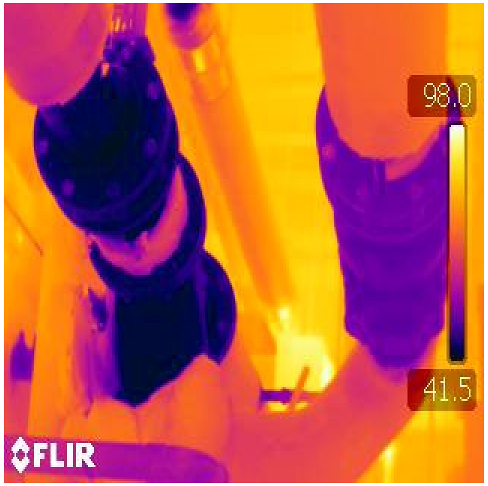
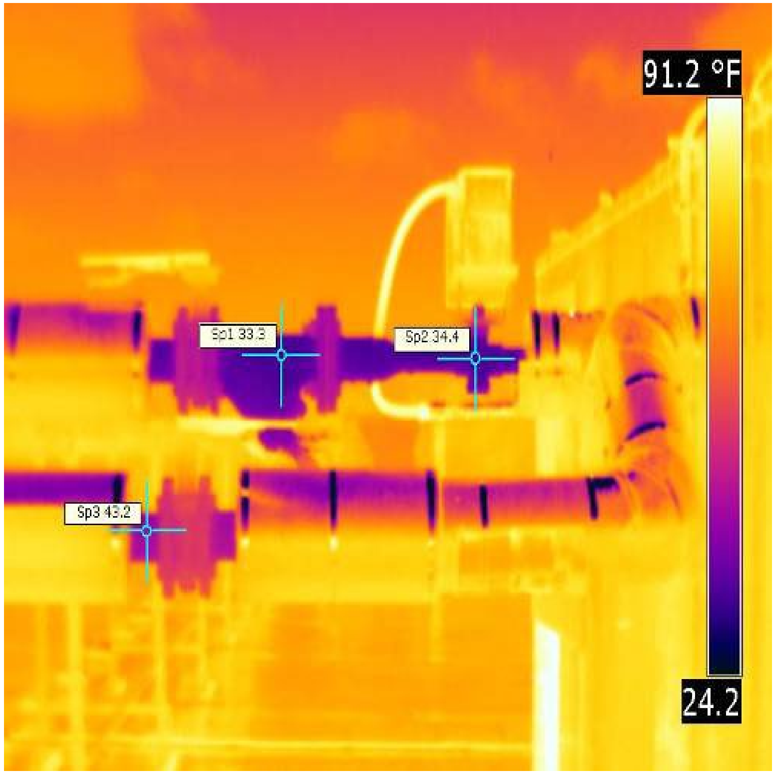
# *Damaged insulation from leak repair never fixed*




Chilled Water
Repair

# *Chilled piping on the roof*

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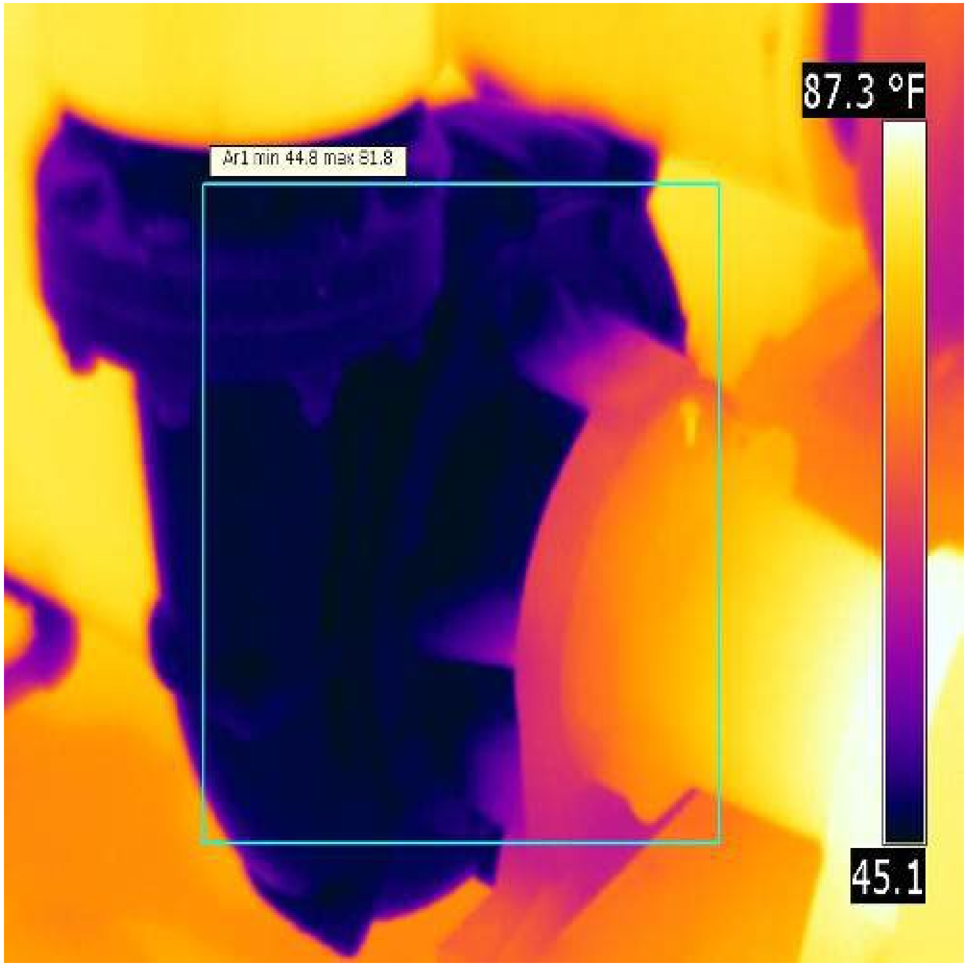
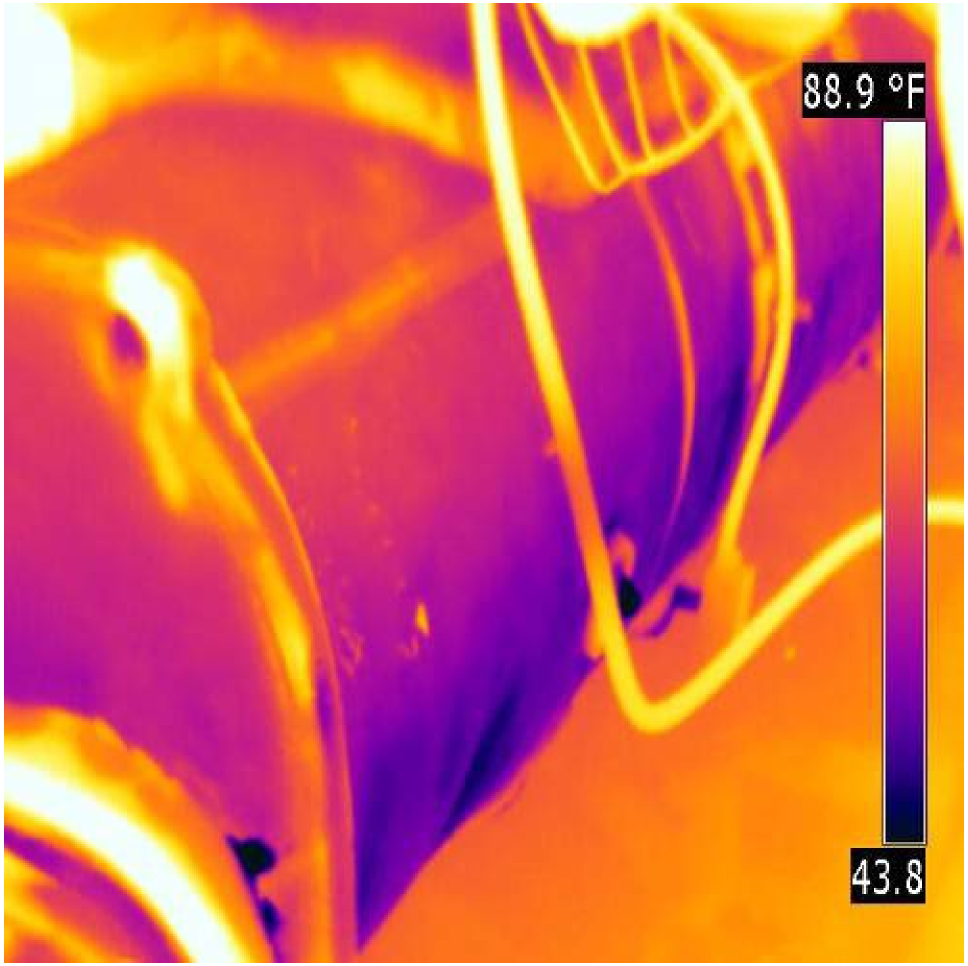
# Chilled Pumps




# *Water Saturated Insulation*

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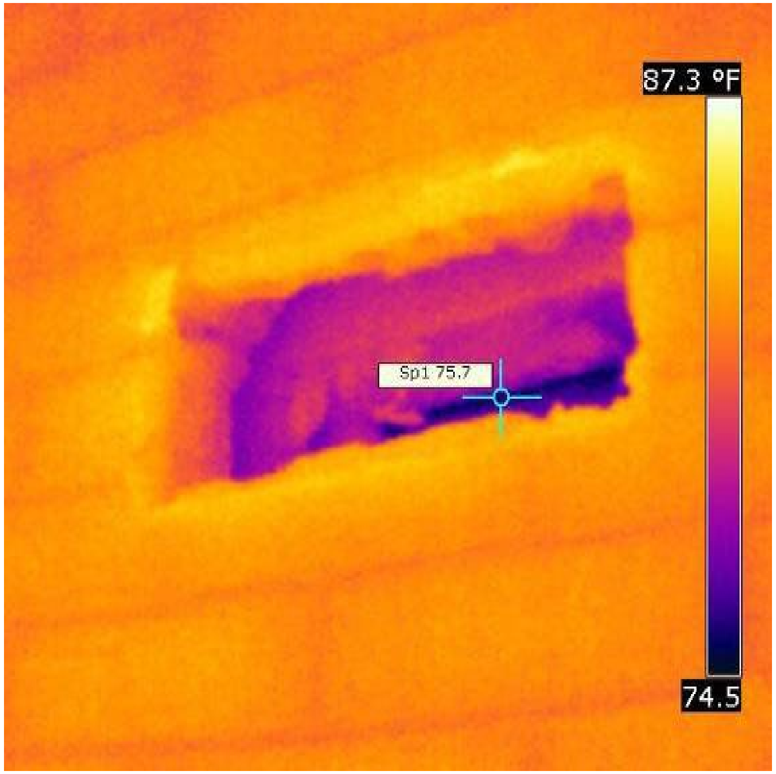
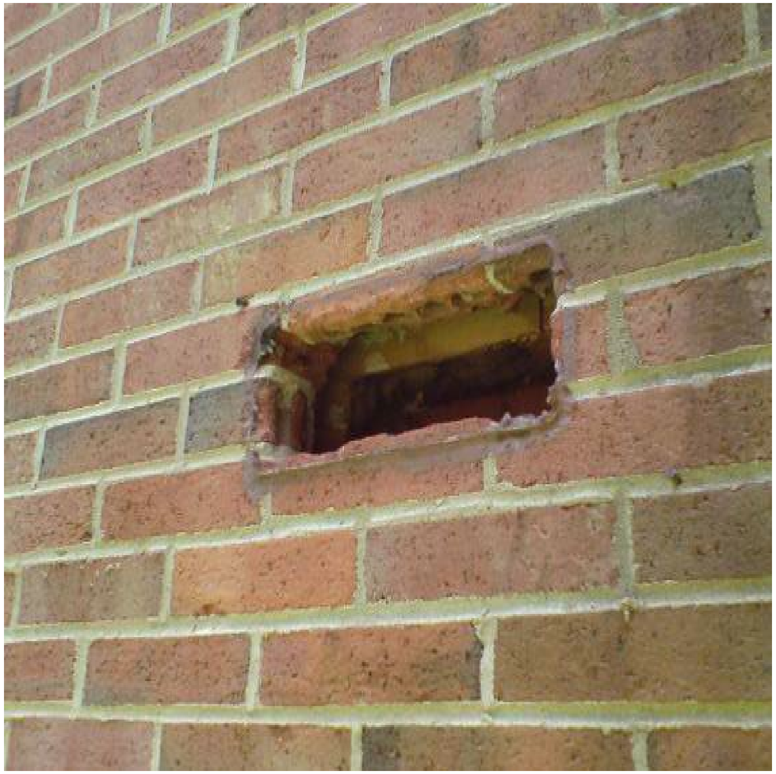
# *Openings in the Building's Envelope*



Some are Obvious

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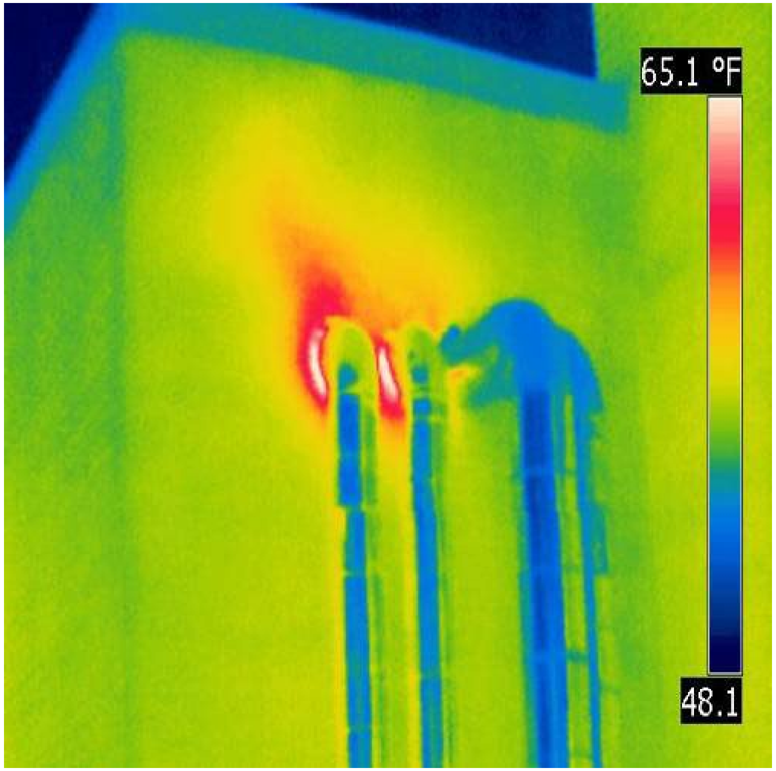
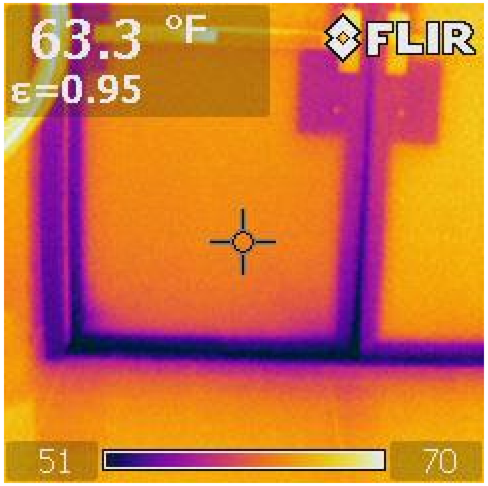
# *SOME NOT SO OBVIOUS*

Note: Only one is showing Energy Loss




# *Infiltration around a door*

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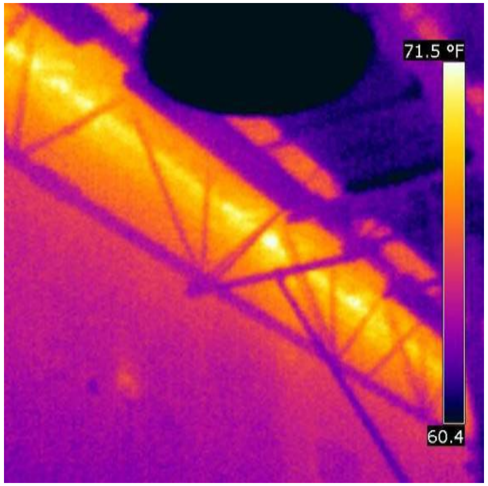
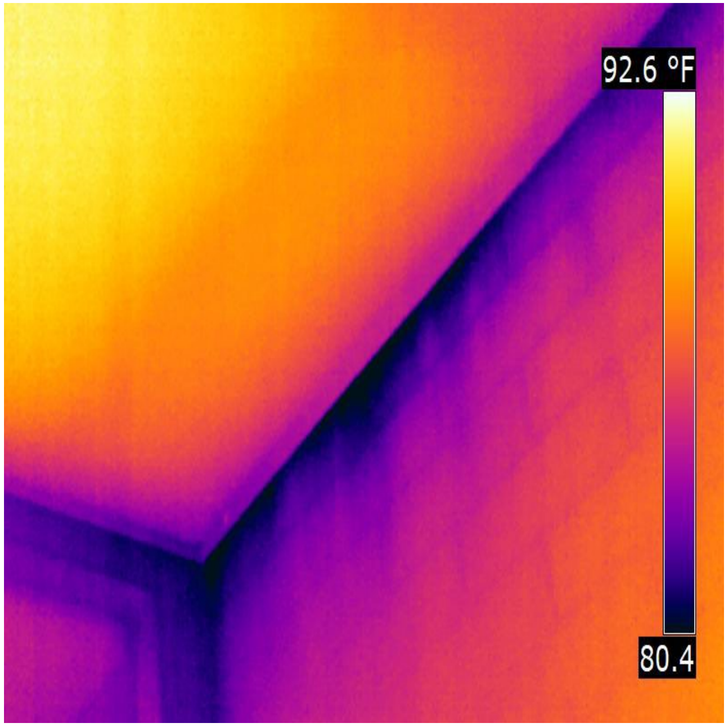
# Infiltration at the head of a wall

# Soffit – Exfiltration




Hot Climate

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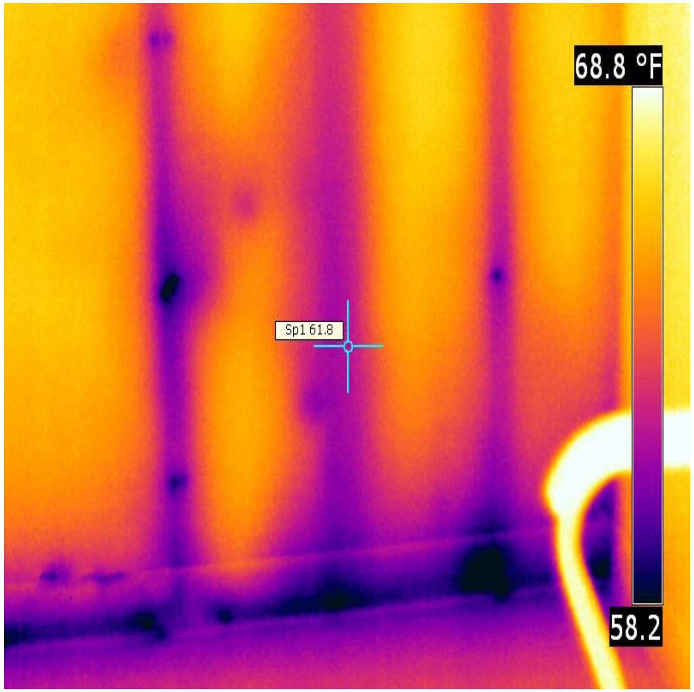
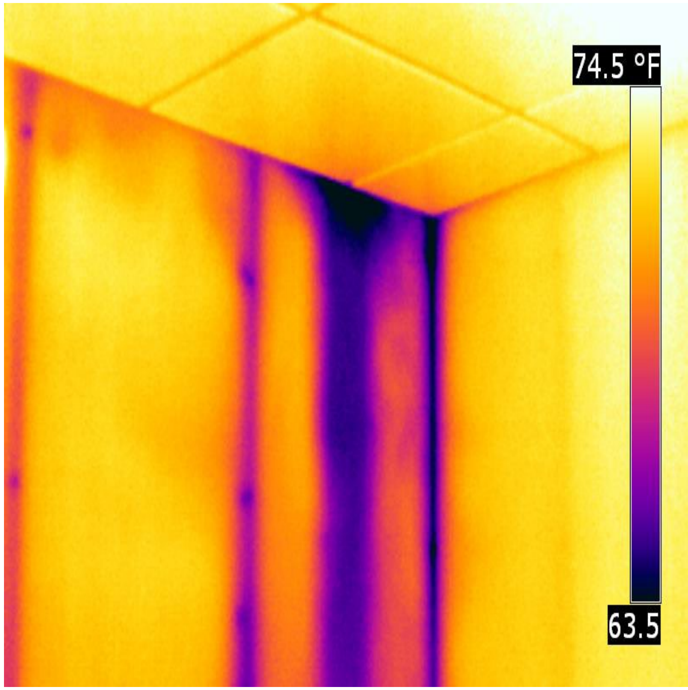
# Poor Insulation and Water Issues

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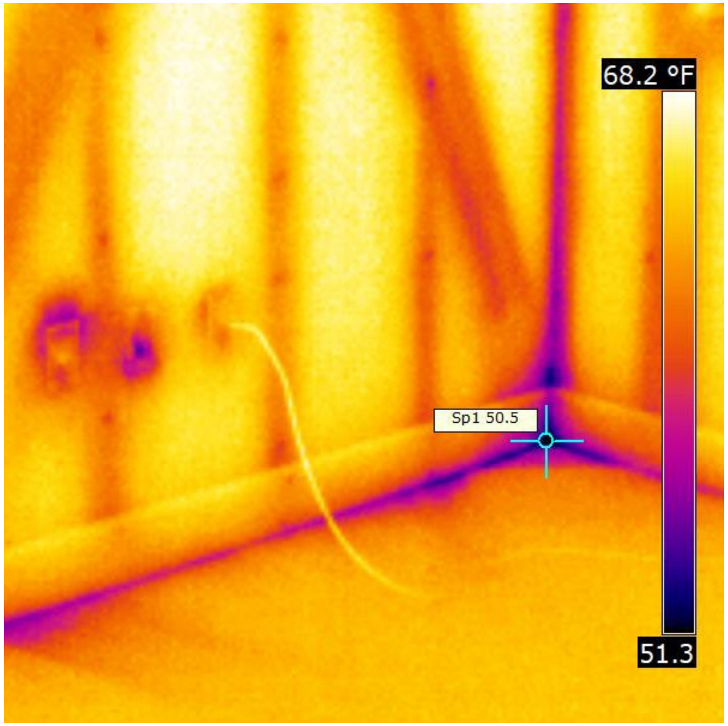
# Walls – Thermal bridging

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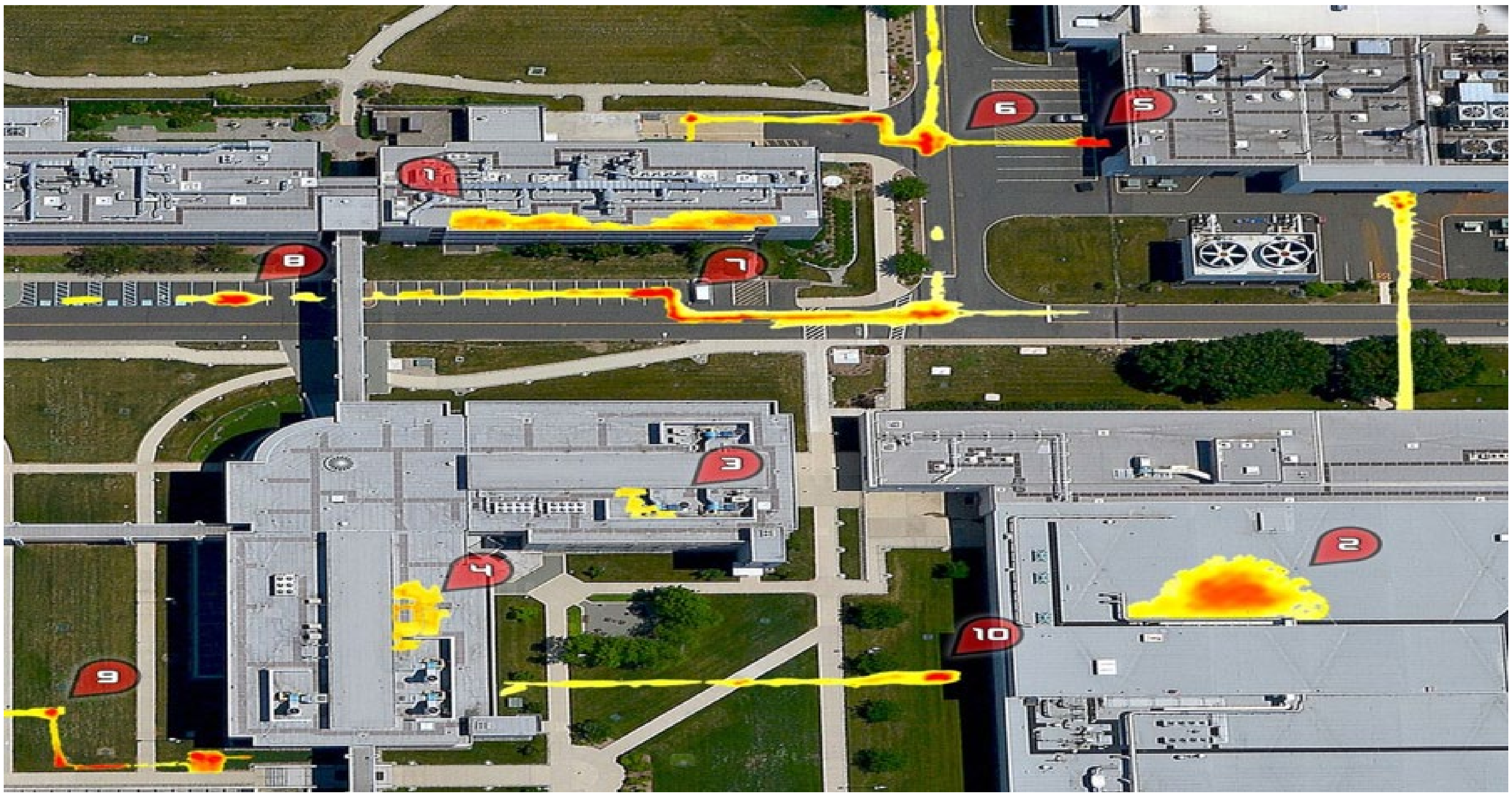
# Roof – Campus IR image of roof issues

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# *Gather Data Necessary to Perform Accurate Calculations*

| | | |
|---|---|---|
| Temperature Which Heating Begins | 70 | °F |
| Temperature Which Cooling Begins | 72 | °F |
| Day Operation Begins (Sunday is Day 1) | 2 | Monday |
| Day Operation Ends (Sunday is Day 1) | 6 | Friday |
| Hour Operation Begins (Hour 1 is Midnight to 1 AM) | 6 | Hour |
| Hour Operation Ends (Hour 1 is Midnight to 1 AM) | 18 | Hour |
| Directional Wind Infiltration/Exfiltration | 70% | per cent |
| Occupied Cooling Temperature Setpoint | 72 | °F |
| Occupied Heating Temperature Setpoint | 70 | °F |
| Unoccupied Cooling Indoor Temperature Setpoint | 85 | °F |
| Unoccupied Heating Indoor Temperature Setpoint | 65 | °F |
| Cooling Plant Efficiency | 1.3 | kW/ton |
| Heating Plant Efficiency | 65% | per cent |
| Energy Cost $/kWh | $ 0.09000 | per kWh |
| Fuel Energy Cost $/MMBtu | $ 23.91000 | per MMBtu |
| # of Floors in Building | 3 | |
| Local Shelter Class (see Table 5 below) | 3 | Typical shelter used by othe |
| $A_r$ = Effective Air Leakage Area from Survey, $ft^2$ | 6.57 | $ft^2$ |

# *BE Calculations are based on ASHRAE 90.1 a Universally Recognized Standard*

These calculations are based on ASHRAE Fundamentals 2009, chapter 16, page 16.23, formula number 48 as shown below.

**Basic Model.** The following calculations are based on the Sherman and Grimsrud (1980) model, which uses the effective air leakage area at 0.016 in. of water. This leakage area can be obtained from a whole-building pressurization test. Using effective air leakage area, the airflow rate from infiltration is calculated according to

$$Q = A_L\sqrt{C_s\Delta t + C_w U^2} \quad (48)$$

*where*

- $Q$ = airflow rate, cfm
- $A_L$ = effective air leakage area, in$^2$
- $C_s$ = stack coefficient, cfm$^2$/(in$^4\cdot$°F)
- $\Delta t$ = average indoor-outdoor temperature difference for time interval of calculation, °F
- $C_w$ = wind coefficient, cfm$^2$/(in$^4\cdot$mph$^2$)
- $U$ = average wind speed measured at local weather station for time interval of calculation, mph

Table 4 presents values of $C_s$ for one-, two-, and three-story houses. The value of wind coefficient $C_w$ depends on the local shelter class **of the building (described in Table 5) and the building height.** Table 6 presents values of $C_w$ for one-, two-, and three-story houses in shelter classes 1 through 5. In calculating values in Tables 4 and 6, the following assumptions were made regarding input to the basic model:

# *MI Calculations are performed by 3E Plus a DOE Recognized Standard*

| | |
|---|---|
| Energy Savings ($): | 31,856 |
| Energy Reduction (Btus): | 2.059E+09 |
| CO2 Reduction (lbs): | 422,952 |
| NOx Reduction (lbs): | 848 |
| Carbon Equivalent Reduction (lbs): | 115,245 |
| Simple Payback (yrs): | 2.39 |
| Internal Rate of Return (%) | 41.85 |
| Net Present Value ($): | 219,182 |

Paybacks, Environmental Reductions and ROI

# Insulation is Greener than Trees

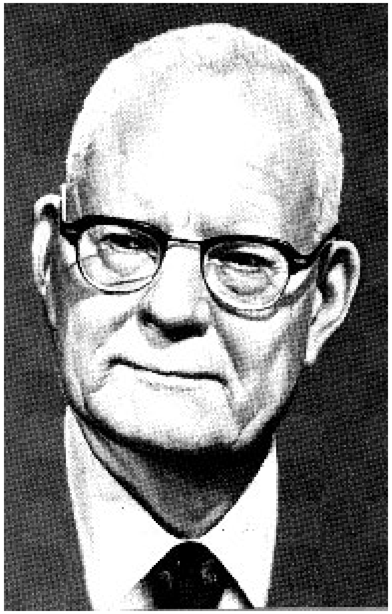
| Carbon Reduction Option | Lbs. of $CO_2$ Per Year |
|---|---|
| 1 ft of insulation on a 350° pipe | 2,308 |
| 1 car, 5% increase in MPG | 570 |
| 1 Compact Florescent Light Bulb | 130 |
| 1 Ft of Insulation on a 180° Pipe | 109 |
| 1 Ft of Insulation on a 42° Pipe | 88 |
| 1 Tree | 50 |

# *Nothing gets done without Performing the Calculations*

Data is Necessary for Financing

"If something can be calculated it can be approved".

W. Edwards Deming



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# Anything Less is…

# *Thank You*

This concludes The American Institute of Architects
Continuing Education Systems Course

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- **Using Infrared Technology to Define Energy saving Opportunities**


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- ***I-Star Energy Solutions***


| Quiz | Answers |
| --- | --- |
| 1. Infrared cameras measure temperature differences T or F? | T |
| 2. Infrared camera images can be intuitively interpreted T or F? | F |
| 3. Infrared cameras measure heat and cold energy T or F? | F |
| 4. Infrared images all use the same colors T or F? | F |
| 5. Training for camera use in not important T or F? | F |
| 6 Infrared can be used to identify air leakage T or F? | T |
| 7. Infrared can be used to find trapped moisture T or F? | T |
| 8. Infrared can be used to find missing insulation T or F? | T |
| 9. Infrared can be used to find electrical resistance T or F? | T |
| 10. Infrared can be used to calculate energy savings T or F? | F |