# Energy Leaders Consortium Visit: Energy Hunt with Mother Parkers

26th Feb 2026

# Quick Self-Introductions

- We all have something to contribute to today's workshop!
  - This is especially so in a Treasure Hunt!
- Name, what you do.
- Experience with energy initiatives
- Expectations for today

# Agenda for Today

- Big Picture Ideas
- The Energy Hunt
  - An Overview
- The Seven Steps
  - A logical approach to understanding how a facility uses energy.
  - A prioritized search for savings
- Facility Walkthrough
- Brainstorming Opportunities
- Estimating Savings
  - for Selected Opportunities
- Summarizing Results
- Closing

# Our Objective for Today: Savings Ideas Quantified

## Manufacturing: Reduce Non-Productive Electricity

- From profile 400-450 kW during non-productive times – est. 75kW reduction.
- Housekeeping Manager's walk around list
  - Lighting, pumps, exhaust & cooling fans, computers, chillers, mixers, etc.
- Savings : $18,000 per year
- Shut-down list procedure required.
- Payback: immediate

# Lots of Opportunities!

Energy Treasure Hunt - Summary Report of Opportunities Identified

| | Opportunity | Comments / Information Needed | Potential | Demand Reduction kW | Consumption Reduction kWh/yr | $/Yr | GHG Reduction (Tonnes) |
|---|---|---|---|---|---|---|---|
| 1 | Optimize UV/Bioreactor. | Investigate operating UV system at different levels to match plant flow | Not estimated as systems is not yet operational. | | | | |
| 2 | Run full or half bioreactor. | Currently the plant is running at ~70% capacity. Energy savings would be minimal as reducing 50% would only be possible for very sh | | | | | |
| 3 | Peak shaving program (peak saver) | 225L Diesel/hr x 2 Generators = 550L/ | | | | | |
| 4 | Review capability of shutting down dewatering system to trim peaks. Schedule on/off one day coordinating with rain events. | Assume the measure could operate at year | | | | | |
| 5 | Investigate repeated 80 kW high power factor load cycling observed on energy histogram. Could potentially be an opportunity for improvement. | Walk around investation suggest that t enough and with a high power factor w coils in large air handling units. | | | | | |
| 6 | Improve control of electric unit heaters throughout site. Upgrade at a minimum to digital, programable wall mounted thermostats. | Could save between 5-10% of heating | | | | | |
| 7 | Insulate cold pipes in tunnels to reduce heat loss from airt and to reduce condensation issues during humid times. | Need length and diamter of pipe and te pipe surface. | | | | | |
| 8 | Install flow guages on pump seal flush supply. | Reduce potable water use. | | | | | |
| 9 | Complete a water audit to identify opportunities for conservation and to find systems/services that could be replaced with effluent water. | Reduce potable water use. | | | | | |
| 10 | Verify AHU suppy air % and optimize where possible. | Need further measurements per air ha | | | | | |
| 11 | Install heat recovery units on AHUs. | Som eunits curreny! have heat recover operating at maximim effectivness. Gi flow measurements effectiveness coul | | | | | |
| 12 | Investigate heat recovery for exhaust fans. | Assume a total of 3,000 cfm of exhaus the heating season with in interior tem proposed heat recovery efficeincy of 7 | | | | | |
| 13 | Optimize piping layouts - install sweeping elbows vs hard 90s. | | | | | | |
| 14 | Centrifuge Room: Install ductless mini-split unit to replace Packaged Terminal Air Conditioner (PTAC) unit. | | | | | | |

| | Opportunity | Comments / Information Needed | Potential | Demand Reduction kW | Consumption Reduction kWh/yr | $/Yr | GHG Reduction (Tonnes) |
|---|---|---|---|---|---|---|---|
| 15 | Review air required for grit chambers to ensure that system is not overdelivering. Single speed blowers. | 168 hrs x 10 HP: Running 365 days x 24hrs day. | Energy Avoidance ~2HP = 1.5kW x 24hr/day x 365 d/yr =~ 13,000 kWh ~= $850/yr | | 13,000 | $ 850 | 3 |
| 16 | Review Riverview influent location to main lift station. | Investigate if this influent could be rerouted to avoid 9m drop to bottom of wet well as it is then pumped back up to enter plant. | Not estimated as deemed not be practical. | | | | |
| 17 | Review once through cooling water on gensets. | Can this water be recycled or perhaps replaced with effluent water? | Low savings due to low genset hours. | | | | |
| 18 | Explore the use of effluent water for seals. | Review the quality requirements for seal water to determine if effluent water can be used. | | | | | |
| 19 | Install energy submeters to help define energy use. | Study currently being completed to assess options. | | | | | |
| 20 | Pump house: install VFDs instead of inlet vanes on fans | 15 HP x 2; 35,000 CFM | Savings: 16,000 kWh = $1,000/yr | | 16,000 | $ 1,000 | 4 |
| 21 | Review belt drive on grit augers. | Consider replacing with direct drive motor - can reduce slip losses by 5-8%. If belts used, recommend using synchronous belts to reduce slipage. Savings assume auger motor of 5 HP for 4,000 hours per year. | 5 HP = ~ 4 kW x 8000 hours x 5% x $0.065/kWh = $100/year | | 1,540 | $ 100 | 0 |
| 22 | Improve connection with NB Power to obtain access to power meter real time data. | | Not estimated. | | | | |
| 23 | Consider destratification fans for centrifuge room | Destratification fans can reduce heating loads by 2-3% | | | | | |
| 24 | Consider mostly open flow control for reactor air flow control to tanks. | Assume 10% improvement. Discusson suggested caution as there is progtamming required to possible instability. | 150HP x 1.5 blowers x 24hrs; 180 kW x 24hrs x 365 x 0.1 = 160,000 kWh/yr = $10,000 | | 160,000 | $ 10,000 | 42 |
| | Plant Totals | | | 750 | 492,040 | $ 67,750 | 130 |

Note: Calculations assume a demand price of $15/kW, energy price of $0.065 per kWh and a GHG factor of 0.26 kg/kWh.

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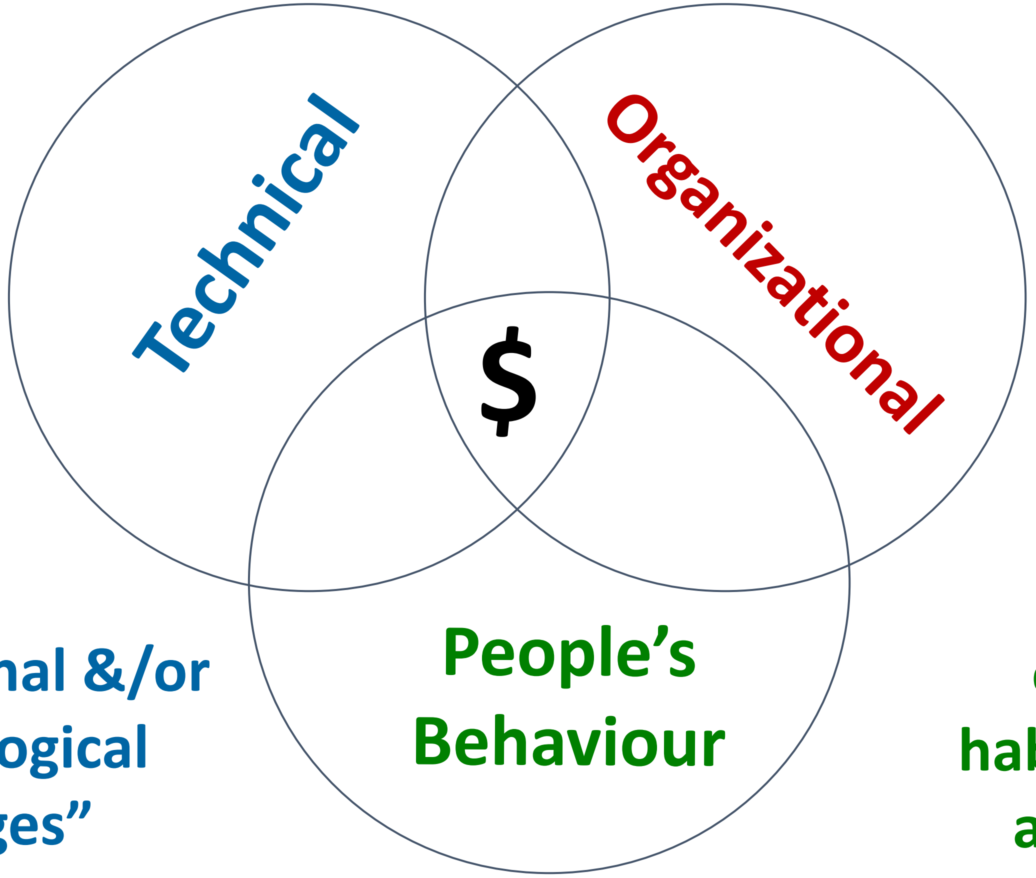
# Big Picture Ideas

No Compromise!

# The Dimensions of Energy Management

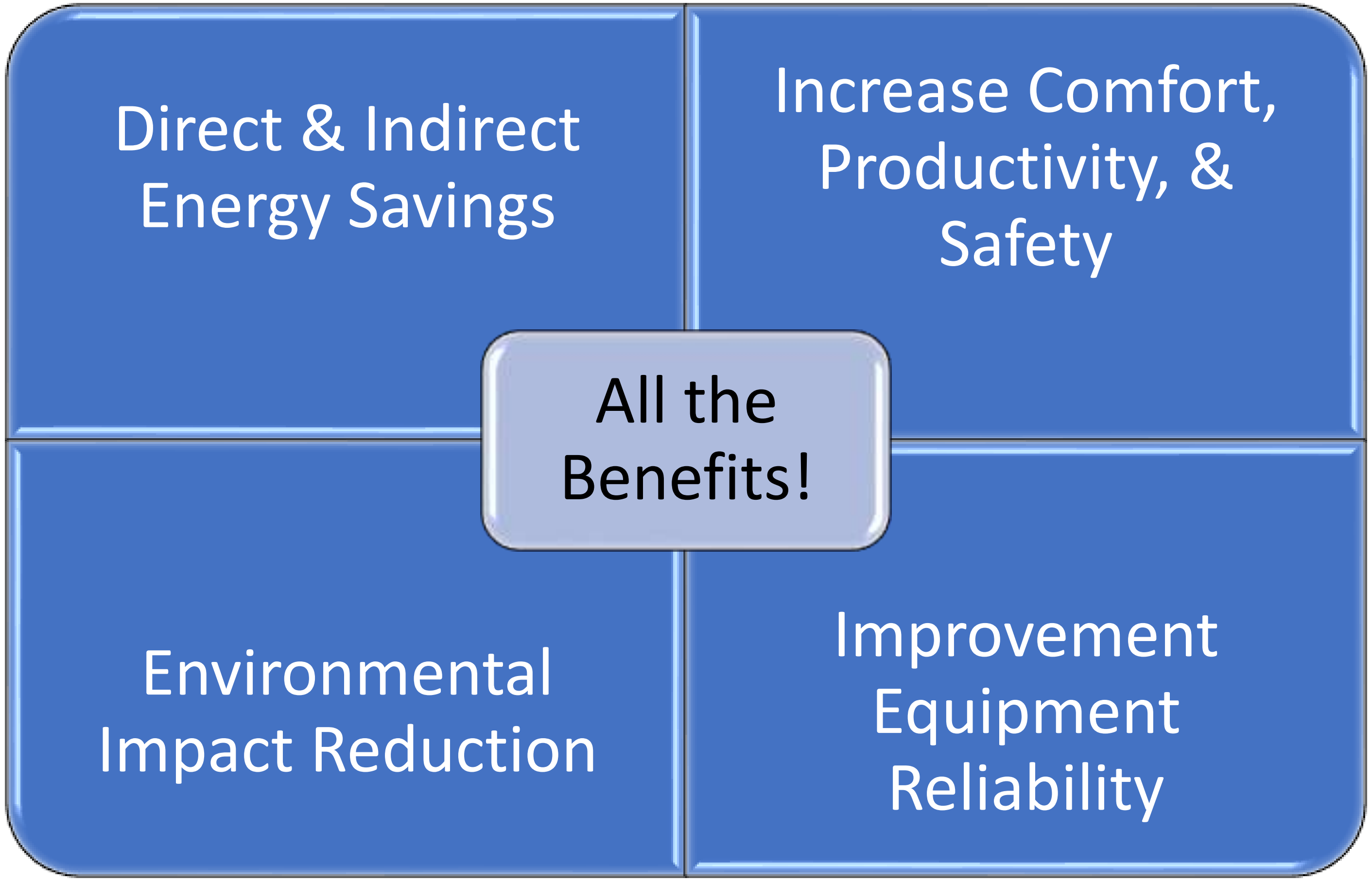
“working together to build an energy managing culture ”




“operational &/or technological changes”

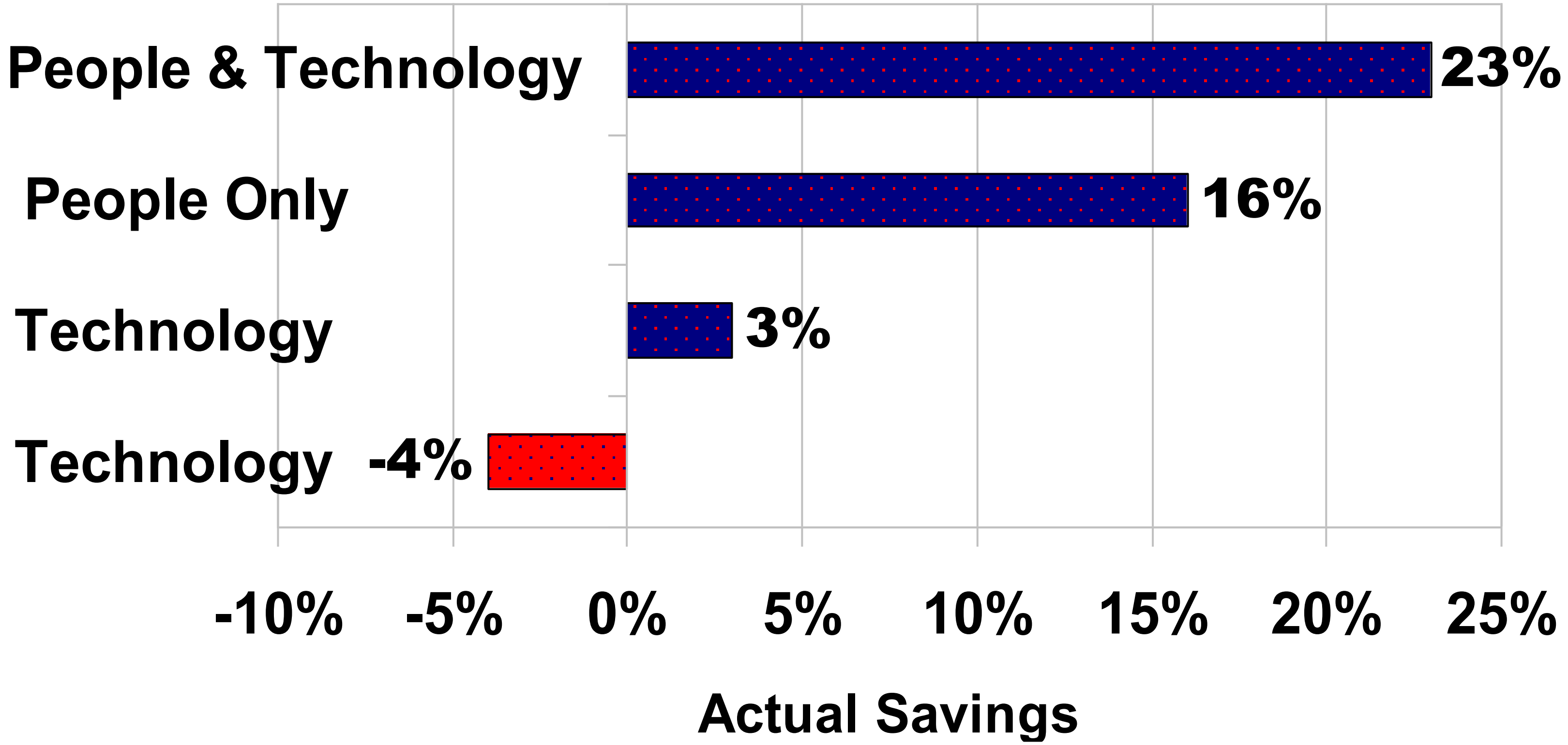
“awareness, engagement, habits, procedures and feedback”

# All of the Energy Management Benefits



# Finally, ~~What~~ Creates Savings?

**Who**




**Source: Good Practice Guide 84 Managing and Motivating Staff to Save Energy**

# The Energy Treasure Hunt

Engaging Staff in the Search For Opportunities

# What is an Energy Treasure Hunt?

- A collaborative search for energy savings opportunities involving staff, energy facilitators and other interested parties
- 2-3 days on-site events for the full-scale Energy Treasure Hunt on large facilities, 1 day for many commercial/small industrial facilities
- Leverages site data to help visualize energy consumption
- Based on the “Kaizen” principle
  - a.k.a. change for the better, continuous improvements
- Used as a tool to identify low and no-cost measures
  - Capital cost measure can be identified and set aside for further evaluation
- Great way for engaging staff/employees and training opportunity
- Leads to a list of practical, actionable items – opportunities.

# Comparing the Treasure Hunt Using The Seven Steps to Other Methods

| | Energy Hunt | Energy Audits | EBCx |
|---|---|---|---|
| **Staff involvement** | Significant | Minimal | Very significant, but varies |
| **Third Party Resources** | Some | Complete | Significant |
| **O&M Measures** | Primary | Varies, secondary | Primary |
| **Capital Measures** | Minimal | Core | Secondary |
| **Learning Opportunity** | Important | None | Important |
| **Time scale** | Short, days/weeks | Very short, days | Months |
| **Cost** | Low | Low to mid | Mid |
| **Planning** | EMP Actions | Capital cost budgets | EMP Actions |

# Advantages of an Energy Hunt

- Its simply a very practical approach.
- Staff know the buildings better than others.
- Staff know the challenges of your buildings.
- Participants often take a lot of $avings home.
- The opportunities discovered are “owned” by those that participate.
- The training aspect leads to more opportunities after the treasure hunt.
- Engagement for all who participate!
- Immediate payback measures can more than pay for the event!

# The EnergyStar Approach… A Full Scale Hunt

## Energy Treasure Hunt: A How-To Guide

During an Energy Treasure Hunt, groups of people walk around a building looking for quick ways to save energy. Many ENERGY STAR partners have used Energy Treasure Hunts to reduce their facilities' energy use by up to 15 percent.

### Treasure Hunts vs. Audits: Two Key Differences

Treasure Hunts focus on quick fixes with a short payback period. Many improvements can be made immediately and without significant expenditures or capital investments.

Treasure Hunts strike a positive, optimistic tone, focusing on outcomes and improving day-to-day operations. And building operators and employees who help "discover" treasure are

### Step 1: Prepare

1

This is the most time-consuming step, but definitely the most important.

**PICK A LOCATION**

Begin by evaluating your portfolio of buildings to identify facilities where energy performance needs to improve or has recently declined. Find one that is willing to host an Energy Treasure Hunt.

**COLLECT BACKGROUND INFO**

Next, work with the building manager to collect:

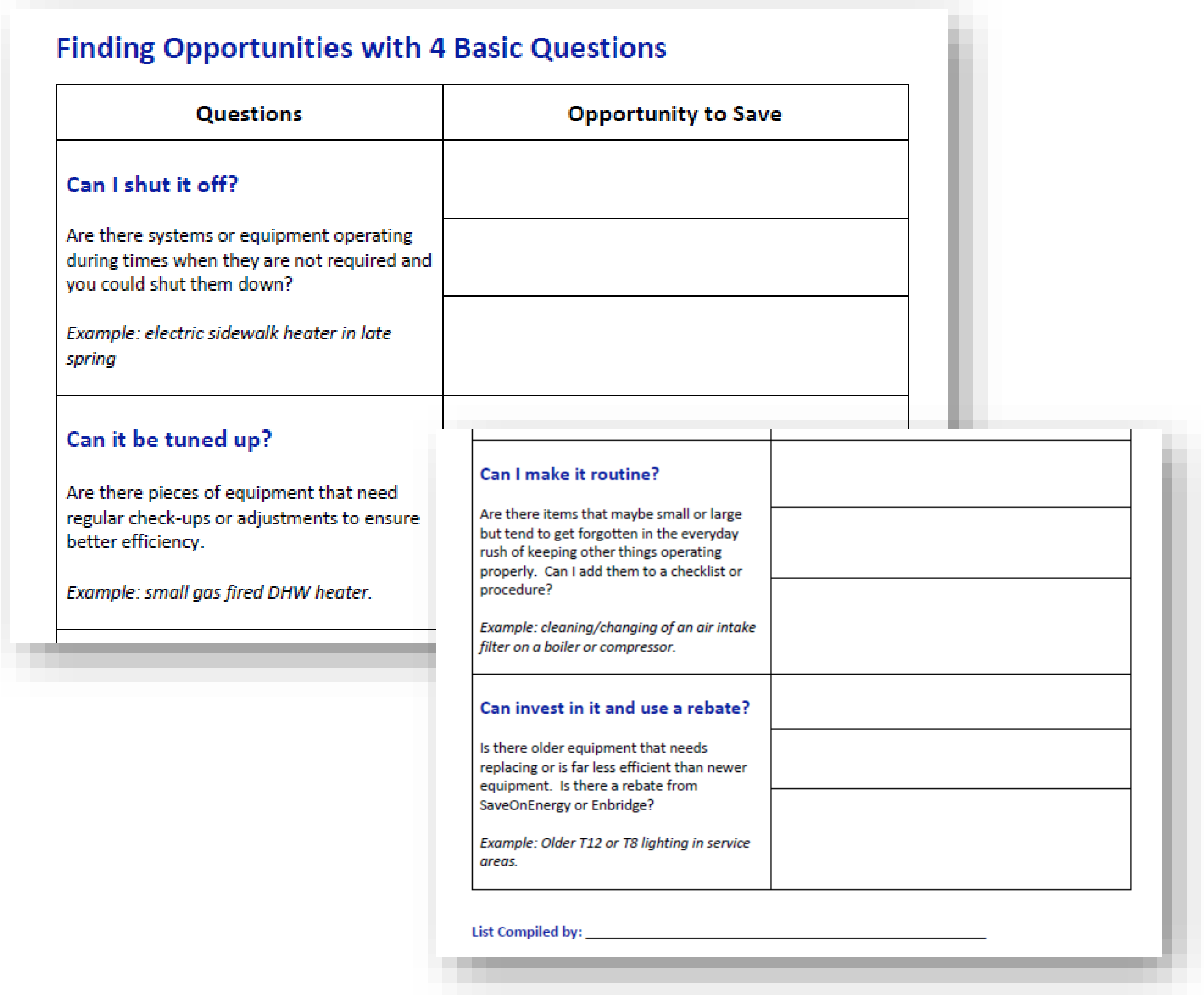
- ❑ Data on energy use, costs, demand, and trends. Include

# The One Day Approach

- Preparation
  - Collect & analyze historical energy data & create lots of charts
  - Customize a ½  day **<u>Seven Steps Workshop</u>**
- Workshop & Energy Hunt Day
  - ½ day **<u>Seven Steps Workshop</u>**
  - Consider and discuss analysis of energy data – ask questions
  - Facility walkthrough
    - Maybe a teams based approach depending on facility size
    - Flipchart ideas
  - Exploration of any online systems or BAS
  - Brainstorm & Flipchart ALL ideas.
  - Quantify as many as possible (using facilitators expertise)
    - Hand calculation, spreadsheet, RETScreen or web tools
  - Summarice Results
    - If appropriate present to management
  - Each participant gets a certificate!
- After the Hunt
  - Organization <u>must</u> take action
  - Celebrate - create a case study, newsletter article or video!

# Critical Questioning Checklist

- Can you shut if off?
  - Or turn it down, or control it better
- Can you tune it up?
- Can you make it routine?
  - Find better practices
- Can you make an investment in it?
  - A lot of incentives/rebates are  available



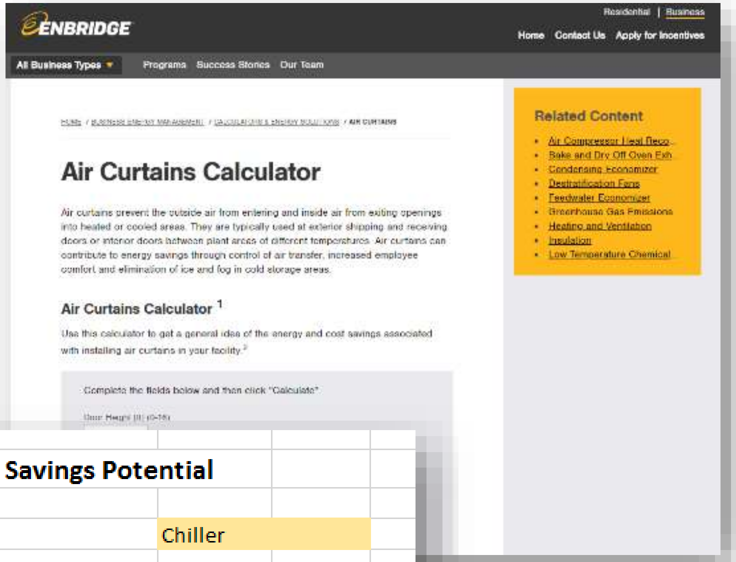
**Finding Opportunities with 4 Basic Questions**

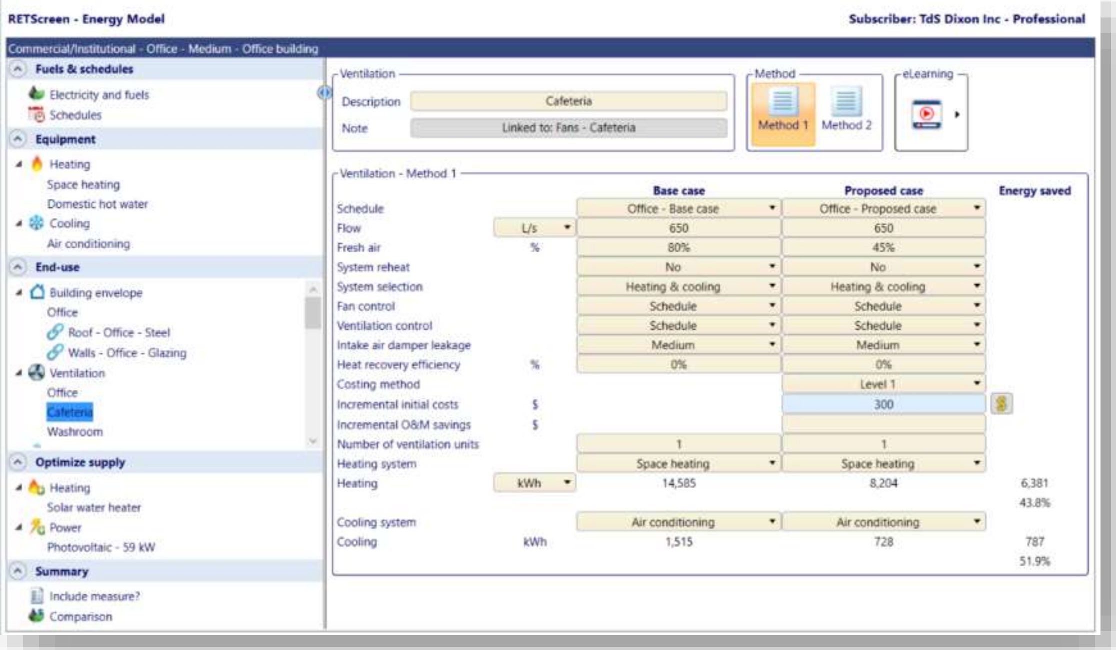
| Questions | Opportunity to Save |
|---|---|
| **Can I shut it off?**<br><br>Are there systems or equipment operating during times when they are not required and you could shut them down?<br><br>*Example: electric sidewalk heater in late spring* | |
| **Can it be tuned up?**<br><br>Are there pieces of equipment that need regular check-ups or adjustments to ensure better efficiency.<br><br>*Example: small gas fired DHW heater.* | |
| **Can I make it routine?**<br><br>Are there items that maybe small or large but tend to get forgotten in the everyday rush of keeping other things operating properly. Can I add them to a checklist or procedure?<br><br>*Example: cleaning/changing of an air intake filter on a boiler or compressor.* | |
| **Can invest in it and use a rebate?**<br><br>Is there older equipment that needs replacing or is far less efficient than newer equipment. Is there a rebate from SaveOnEnergy or Enbridge?<br><br>*Example: Older T12 or T8 lighting in service areas.* | |

List Compiled by: ______________________________

# Analyzing Data & Estimating Savings

- Using various tools
  - Spreadsheet
  - RETScreen Expert
  - Online (Web) Calculators




| Optimal Start/Stop Savings Potential | | |
|---|---|---|
| Equipment | Chiller | |
| Motor Size | 100 | HP |
| Motor Loading | 90% | |
| Hour Reduction with Optimal Start/Stop | 2.0 | hrs/day |
| Days per Year | 120 | |
| Estimated Motor Power | 74.6 | kW |
| Annual Energy Savings | 17,904 | kWh/yr |
| Energy Price | $0.14 | /kWh |
| Annual Cost Avoidance | $2,507 | |
| Annual Carbon Avoidance | 0.9 | tonnes |

# Tools for Savings Estimates

| Identified Measure / Situation | Calculation | Tool |
|---|---|---|
| Addition of variable frequency drives on main cooling water pumps | Estimate flow reduction & hours | RETScreen, Excel |
| WX Strip on rollup and person doors - dock levelers | Infiltration Rate | RETScreen |
| Insulation on roll-up doors | Heat Loss Analysis | RETScreen |
| In plant offices lighting retrofit from T12 fluorescent | Lighting Calculator | RETScreen or Excel |
| Formalize shut down procedure - train supervisor – trim demand profile. | Estimate load and hours | Excel |
| Night walkthrough - with shut down and check profile | List equipment, loads and hours | RETScreen or Excel |
| Personal fans - control and shut down. | Estimate load and hours | RETScreen or Excel |
| Paint mixer motor to electric from air if conditions allow. | Compressed Air | RETScreen |
| Motion sensor on new LED fixtures as appropriate - low occupancy times. | Lighting Calculator | RETScreen |
| Motion sensors on paint booths - or interlock to fans - stage banks. | Ventilation Calculator | RETScreen |
| OH high speed doors - reduced infiltration - with sensors. | Web calcualtor | Enbridge |
| Remote controls for overhead doors to be mounted on tow motors | Web calculator | Enbridge |
| Motion & occupancy control of supervisot offices and washrooms. | Lighting Calculator | RETScreen |
| High bay uninsulated sections | Heat Loss Analysis | RETScreen |
| Check power factor correction and adjust as required | Excel calculation | Excel |
| Satellite air compressor for 24/7 Process to shutdown central compressor | Compressed Air | RETScreen |
| Water system for blowing chips rather than compressed air. | Compressed Air | RETScreen |
| Add pipe insulation on along runs of pipe in high bay areas. | Insulation calculator | NAIMA 3E Plus |

# Energy Basics

# Electricity & Natural Gas

| How Fast $ | How Much $ |
|---|---|
| How Big x How Many | How Fast x How Long |
| Demand (Peak) | Consumption |
| When | |
| Power | Energy |
| Kilowatts | Kilowatt X hours |
| $\frac{kW}{kVA}$ = Power Factor | kWh |
| | 1 kWh = 3,412 BTU |
| Kilovolt-amps | $m^3_{(Nat\ Gas)}$ = 10.5 kWh |
| 1 HP = 746 Watts | J, kJ, MJ, GJ |
| 1 Ton = 12,000 BTU/hr (Refrigeration) | Approx. 1 BTU |

# What is Efficiency?

$$\text{Efficiency} = \frac{\text{Useful Output}}{\text{Input}} \times 100\%$$

| Device | Efficiency | Input – Output |
|---|---|---|
| Electric heat | 100% | Elec. – Heat |
| Lighting | 2-20% | Elec. – Light |
| Motors | 50-95% | Elec. – Power |
| Pumps and Fans | 20-60% | Elec. – Flow |
| Compressed Air System | 5-15% | Elec. – Air |
| Atmospheric boiler | 50-80% | Gas – Heat |
| Condensing boiler | 80-95% | Gas – Heat |
| Heat Pump | 100-400% | Elec - Heat |

# The Seven Steps

A Methodical Approach to Finding Energy Savings Opportunities to be Used in an Energy Hunt

# The Seven Steps to Understanding & Reducing Energy Consumption

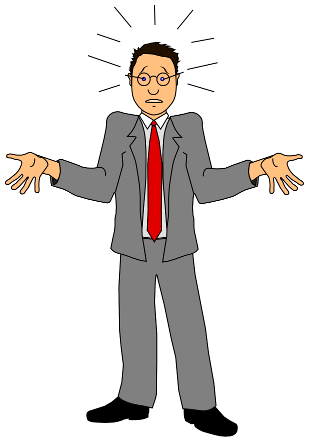
1. Understand Consumption Price & Cost
2. Compare Yourself to Benchmarks
3. Understand When Your Building Uses Energy
4. Understand Where Your Building Uses Energy
5. Eliminate Energy Waste
6. Improve Efficiency
7. Optimize Energy Supply

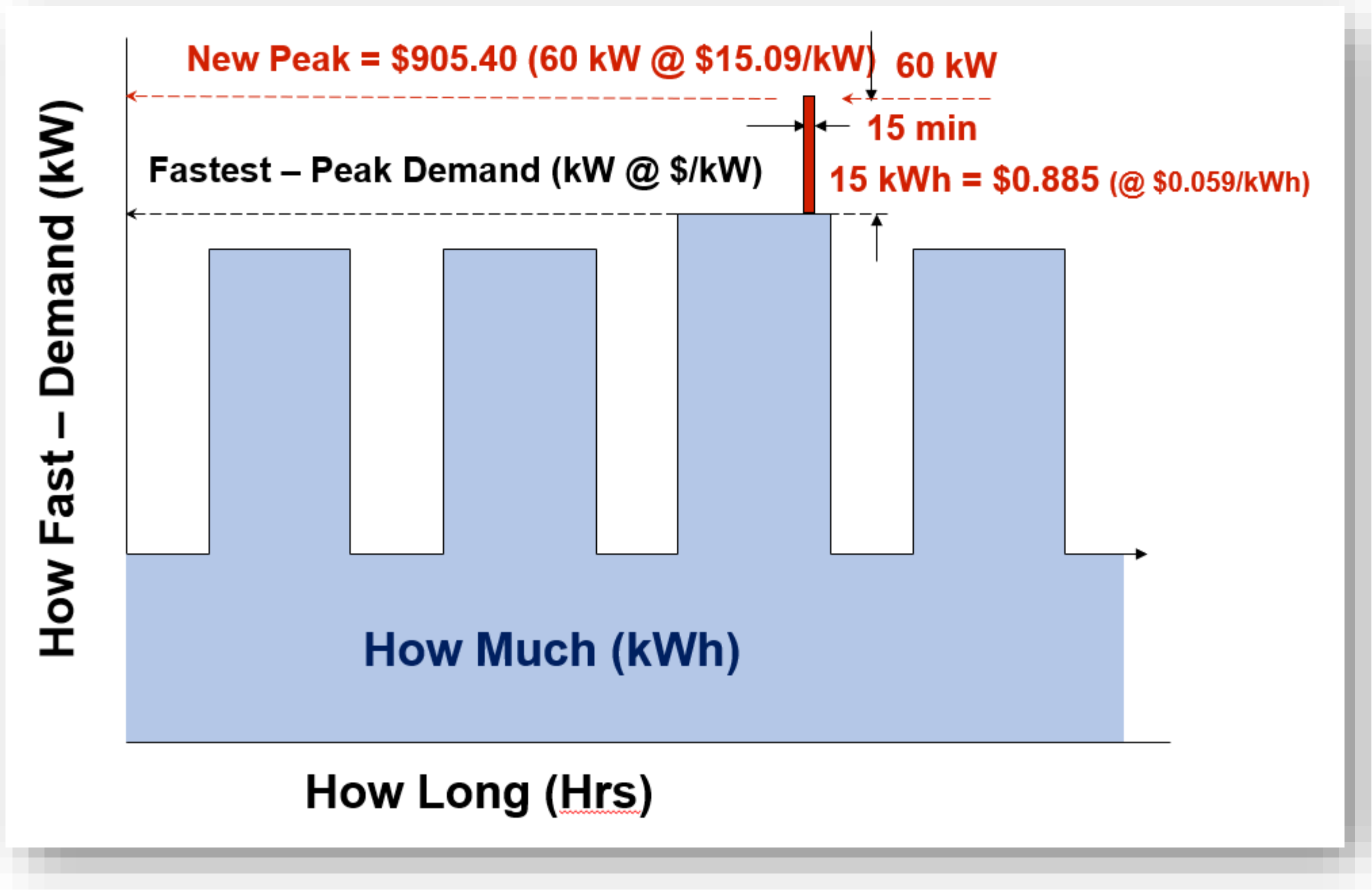
# Step 1. Understand Consumption, Price & Cost

**Example – Electricity**

- January ’05
  590,000 kWh … $55,332
- February ’05
  590,015 kWh … $56,239

- Energy Up 0.003%
- Cost Up 1.6% ???
- >$60 per kWh



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# The Electricity Bill

## Simplified Alectra General Service (50-499) & 500-4,999 kW

- Customer Charge ($99) $2,266/ month
- Distribution Charges * ($15.30) $12.08/kW — Demand
- Energy Charge (OEMP) variable / kWh
- Regulatory Charge $ 0.0053 / kWh
- Global Adjustment
  - Class B: - $0.04 to + $0.12/kWh
  - Class A: based on facility contribution to Ontario peaks

Energy

*** Delivery = Distribution + Transmission**

- **small, non-demand <50kW users pay for delivery on a kWh basis.**

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# Global Adjustment For Class A

- Based upon contribution to 5 top Ontario peaks – demand not energy related
  - Your peak demand factor (PDF) x Ontario system wide global adjustments ($)
- Example:
  - System wide GA is $1120.1 million
  - PDF is 0.00017378
  - Customer global adjustment is
    = $1,120,100,000 X 0.00017378 = $194,654.84
- Savings by reducing your facility contribution to Ontario system peaks
  - Adding 1kW to one peak could cost upward of $60!
  - $300 + for all 5 peaks

# Ontario Demand & Price Information

Tuesday, February 24, 2026

## Demand

Hourly Ontario Demand
10:00 PM EST
**19,562 MW**

| | |
|---|---|
| Projected Demand<br>11:00 PM EST | 18,814 MW |
| Today's Projected Peak<br>8:00 PM EST | 20,836 MW |

All data is available through the Data Directory.

Follow the IESO's Peak Tracker to monitor forecasted Ontario demand for the next 24 hours.

## Supply

Hourly Output by Fuel Type (Transmission-Connected)
10:00 PM EST

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Nuclear | 8,797 MW | Hydro | 3,700 MW | Gas | 5,233 MW | Storage | 464 MW |
| Wind | 3,509 MW | Solar | 0 MW | Biofuel | 14 MW | | |
| Hourly Imports | | | 1,246 MW | Hourly Exports | | | 4,097 MW |

## Global Adjustment Rates

Global Adjustment values will be finalized 10 business days after month end.

$/MWh ¢/kWh

| Date | 1st | 2nd | Actual Rate |
|---|---|---|---|
| Feb 2026 | -0.29 | | |
| Jan 2026 | 1.44 | 0.95 | -4.06 |
| Dec 2025 | 2.23 | -2.57 | -0.29 |
| Nov 2025 | 3.96 | 2.55 | 1.82 |
| Oct 2025 | 7.48 | 4.22 | 4.89 |
| Sep 2025 | 0.30 | 8.19 | 6.19 |

## The Market Day

Price | Ontario Demand

DA-OZP ($/MWh)

| HE | | HE | | HE | | HE | |
|---|---|---|---|---|---|---|---|
| 1 | 60.72 | 7 | 58.81 | 13 | 41.41 | 19 | 81.90 |
| 2 | 55.55 | 8 | 70.52 | 14 | 38.27 | 20 | 78.80 |
| 3 | 53.19 | 9 | 64.95 | 15 | 37.25 | 21 | 72.17 |
| 4 | 52.82 | 10 | 54.58 | 16 | 41.43 | 22 | 52.44 |
| 5 | 48.71 | 11 | 52.05 | 17 | 49.34 | 23 | 58.86 |
| 6 | 45.79 | 12 | 53.28 | 18 | 60.67 | 24 | 54.33 |

## The Ontario Price

The Day-Ahead Ontario Zonal Price (DA-OZP) and the Load Forecast Deviation Adjustment (LFDA) sum to establish the Ontario Price, also known as the average Ontario Electricity Market Price (OEMP), published the 20th day of the following month.

Preliminary LFDA values are available soon after month end, and can be confirmed in the Monthly Market Report.

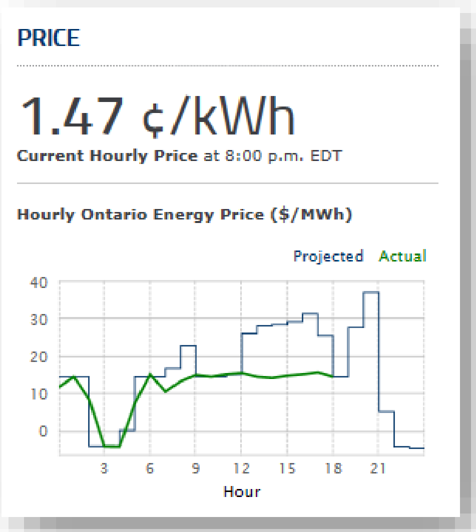
Arithmetic ($/MWh) | Weighted ($/MWh)

| Date | DA-OZP | LFDA | Ontario Price (OEMP) |
|---|---|---|---|
| Jan 2026 | 132.42 | 0.79 | 133.21 |

Source: ieso.ca

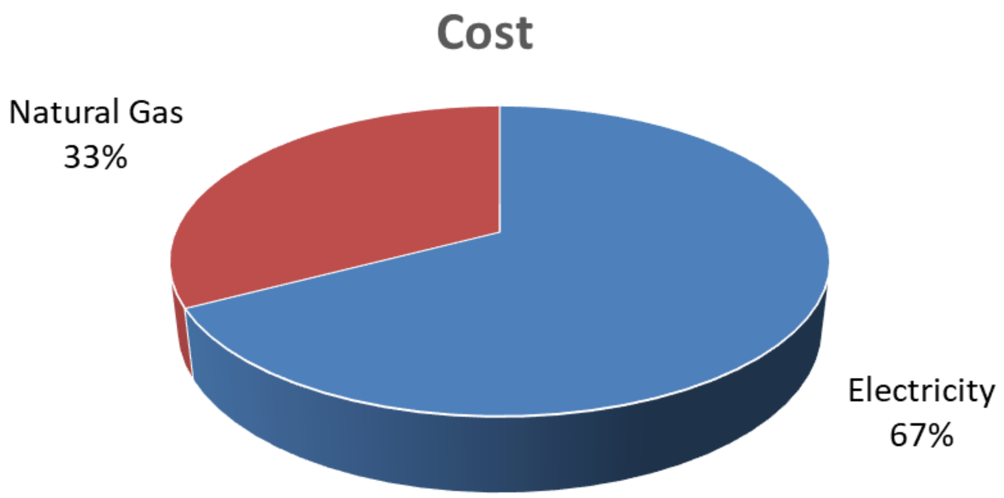
# The Incremental (Marginal) Price of Energy

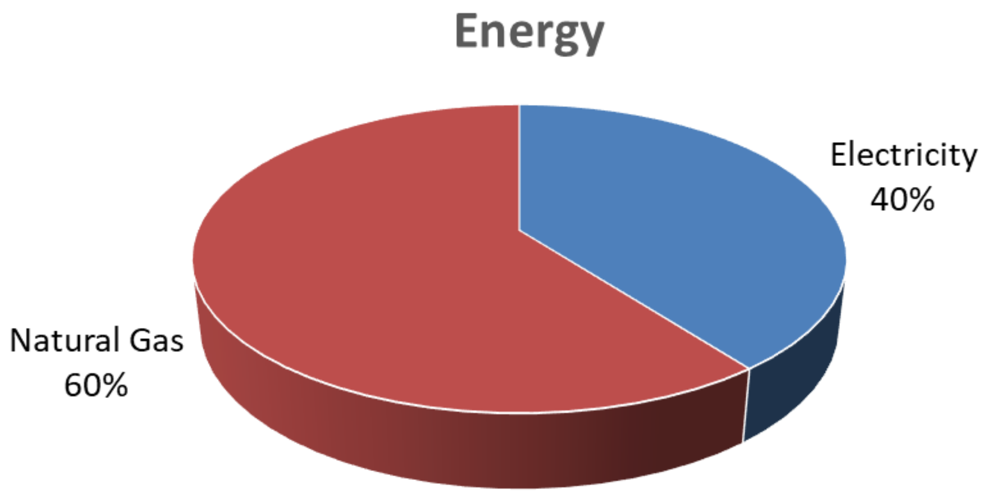
- Electricity
  - Demand ~ $ _______/kW
  - Energy ~ $ _______ /kWh (Class B)
  - ~ $ _______ /kWh (Class A)
- Natural Gas
  - Total ~ $ ________ /m³
- What is the incremental price?
  - The next unit used or saved
  - <u>Important for proper savings calculations.</u>
  - Check your bills and rates.



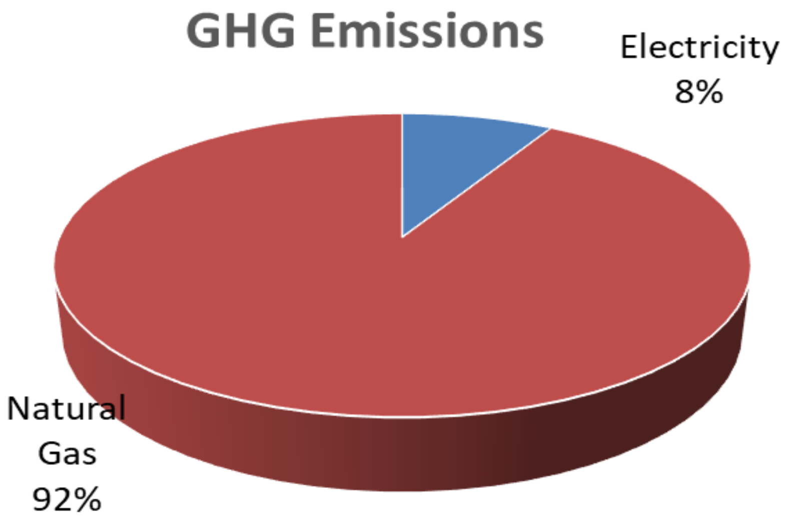

# Cost , Energy & Carbon

## Sample Facility



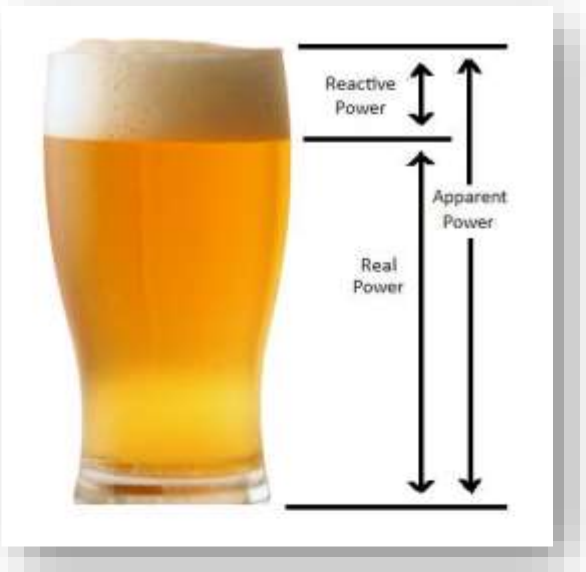




| | Units | ekWh | Cost | GHG (Tonnes) |
|---|---|---|---|---|
| **Electricity** | 1,588,509 | 1,588,509 | 273,393 | 40 |
| **Natural Gas** | 233,135 | 2,424,604 | 132,887 | 434 |
| | | | 406,280 | 473 |



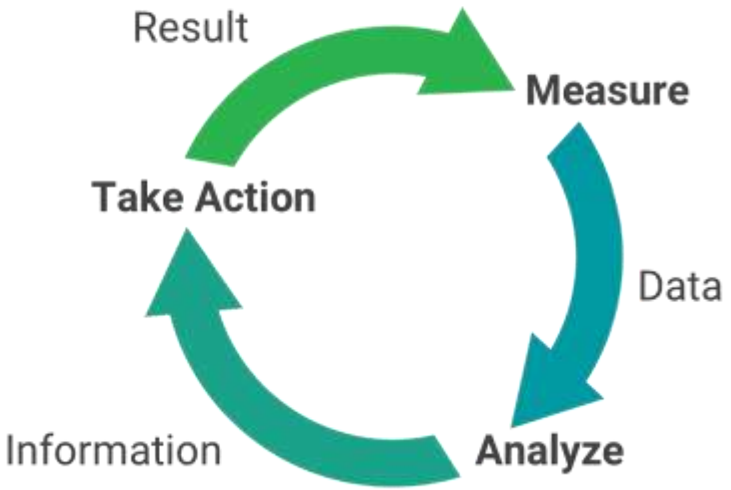
# Understanding Cost - Actions

- Establish correct incremental prices for demand, energy & natural gas.
- Check power factor.
- Check relative cost of demand, electrical energy and natural gas.
- Impact of rates/tariffs/market mechanisms on price related to activity.



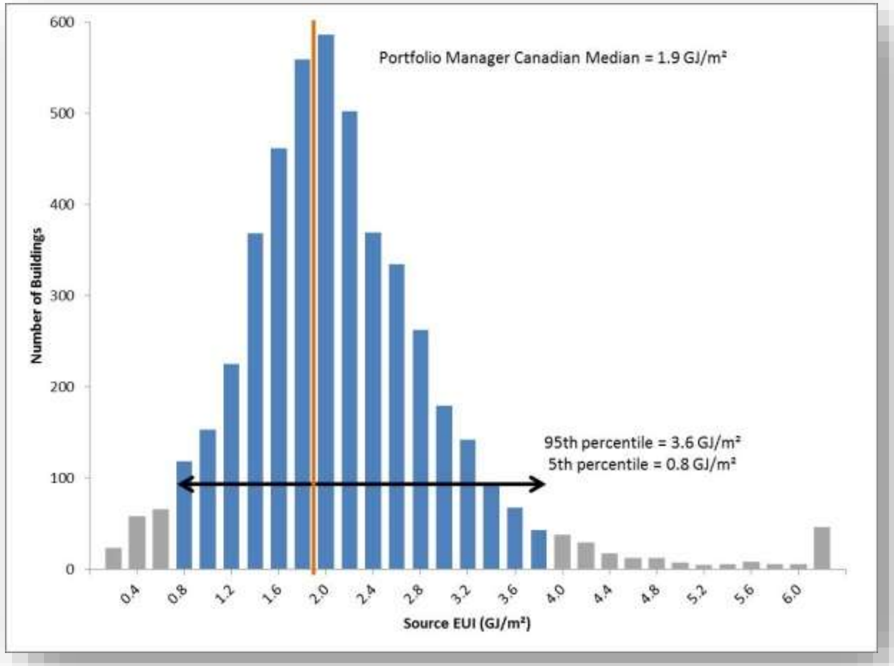

# Step 2: Compare Yourself

- Externally
  - Benchmarking
  - Associations
- Internally
  - Compare to facilities in your portfolio
  - Compare a facility to itself over time
- Energy Utilization Index (EUI)
  - **ekWh/ft$^2$/year**
  - **GJ/widget produced**




# Benchmarking…

- The process of comparing one’s performance metrics to better, best, median and historical performance
- Benchmarking usually leads to:
  - ✓increased knowledge about how one’s building is performing
  - ✓a desire to improve one’s performance
    - ✓through better practices
  - ✓a dialogue/investigation of differences between buildings
  - ✓the development of baselines and improvement targets
  - ✓monitoring of all energy performance




Canadian National Median Reference Values for All Portfolio Manager Property Types

| Broad Category | Primary Function | Further Breakdown (where needed) | Source EUI (GJ/m²) | Site EUI (GJ/m²) | Reference Data Source - Peer Group Comparison |
|---|---|---|---|---|---|
| Banking / Financial Services | Bank Branch<br>Financial Office* | | 1.31 | 0.92 | SCIEU - Offices |
| | Adult Education | | 1.44 | 1.18 | CIBEUS – Adult Education and |

# Types of Benchmarking

- Longitudinal Benchmarking
  - **Comparing a building to itself over time**
    - Could be by sub-system or end-use
  - Normalizing for drivers such as area and weather
    - aka Monitoring
- Cross Sectional Benchmarking
  - **Comparing a building to a group of similar buildings – internal & external**
  - Normalizing for drivers such as area and weather
  - Examples:
    - Portfolio Manager Energy Star (1-100) Score
    - Comparison to Median

**Dashboard** (Metrics current as of 06/04/2021 11:01 AM EDT)

Search by ID or Name

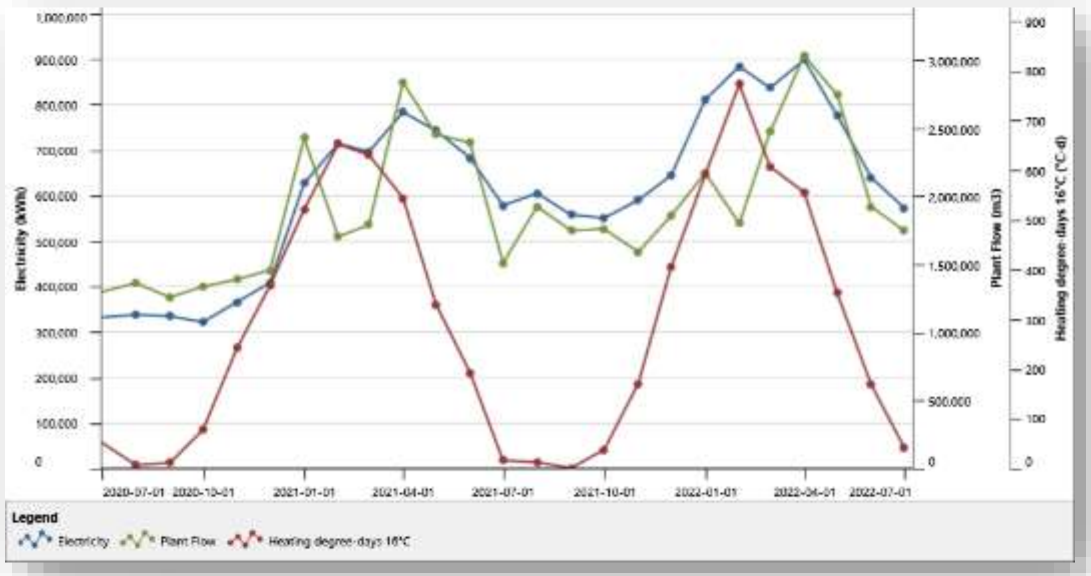
Properties not in a Group (4) | Energy Highlights | **Refresh Metrics**

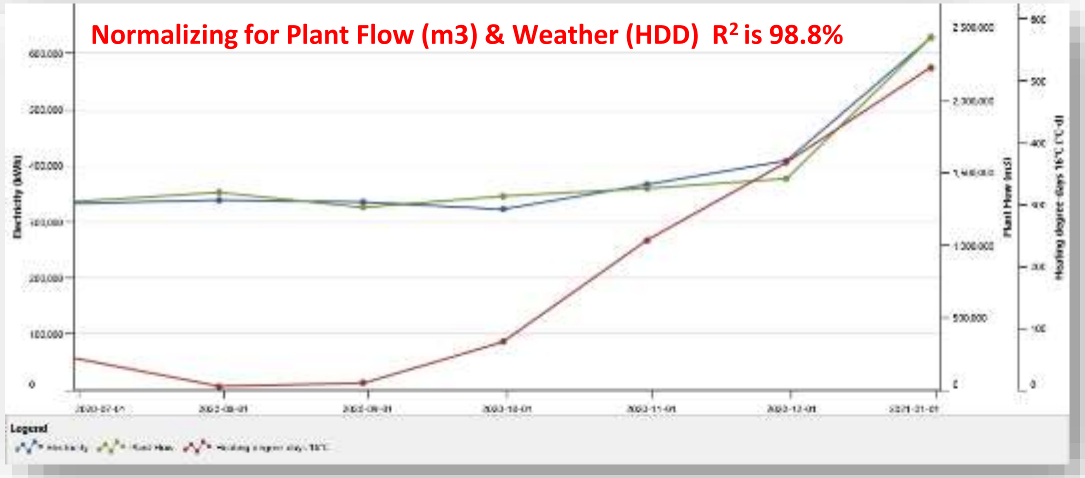
Add/Edit/Delete Groups | Add/Edit/Delete Views

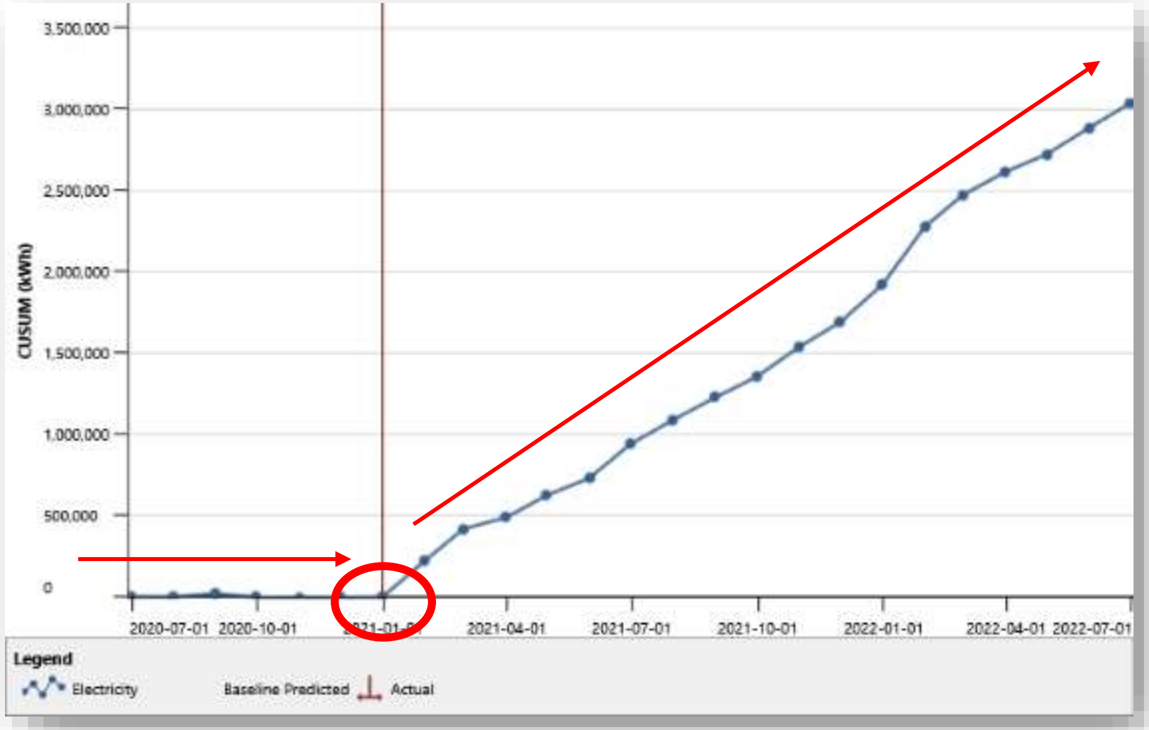
| Name | Energy Current Date | ENERGY STAR Score | Site EUI (GJ/m²) | Source EUI (GJ/m²) |
|---|---|---|---|---|
| Knowenergy Centre 9485688 | 12/31/2019 | 81 | 0.75 | 1.06 |
| Large Learning Centre 13249045 | 10/31/2020 | 56 | 0.96 | 1.21 |
| M&S Building 9768734 | 10/31/2019 | 66 | 0.76 | 1.05 |
| TdS Place 12978946 | 11/30/2018 | 69 | 1.24 | 1.77 |

First | Previous | Page 1 of 1 | Next | Last | 100 | View 1 - 4 of 4

# Comparing the Plant to Itself Monthly

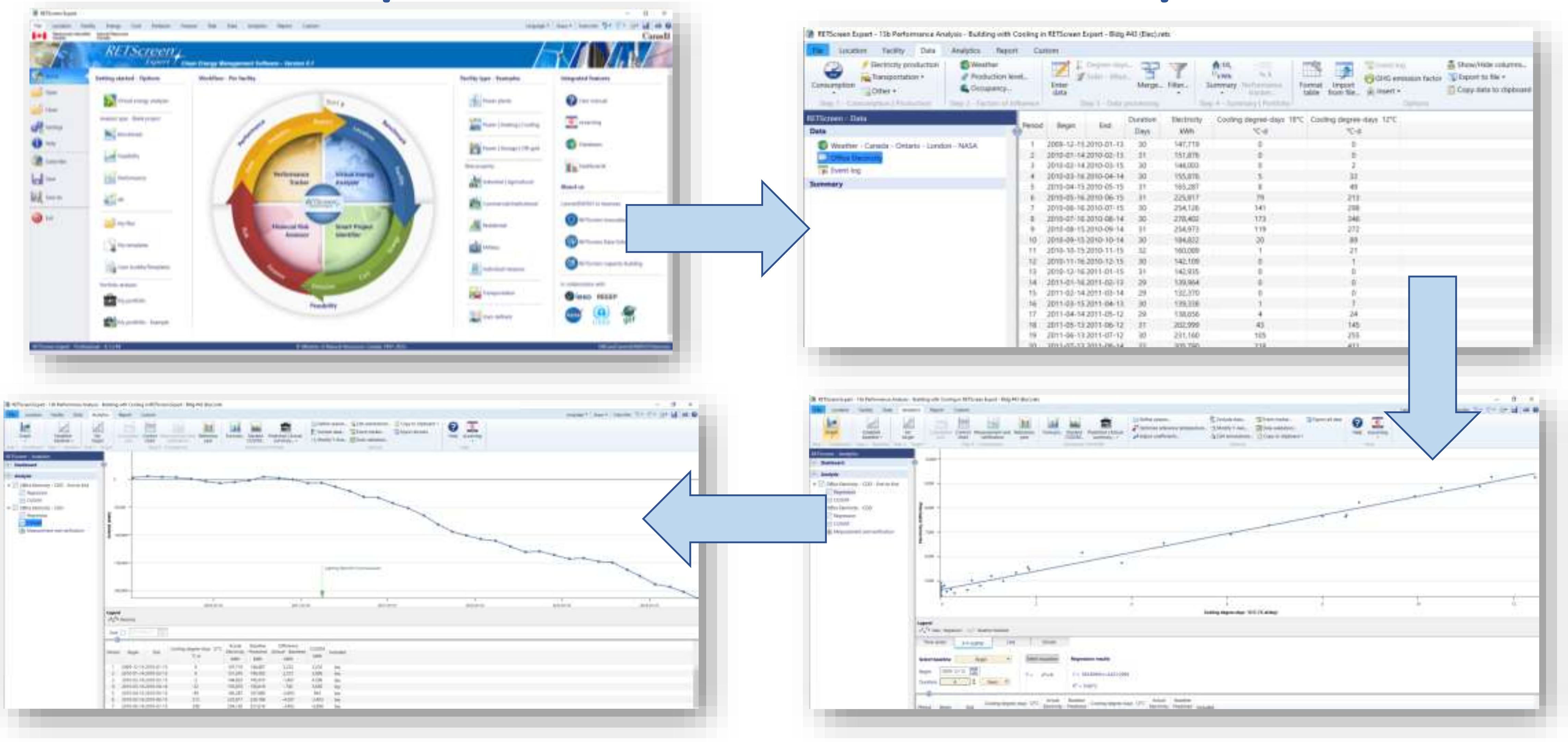


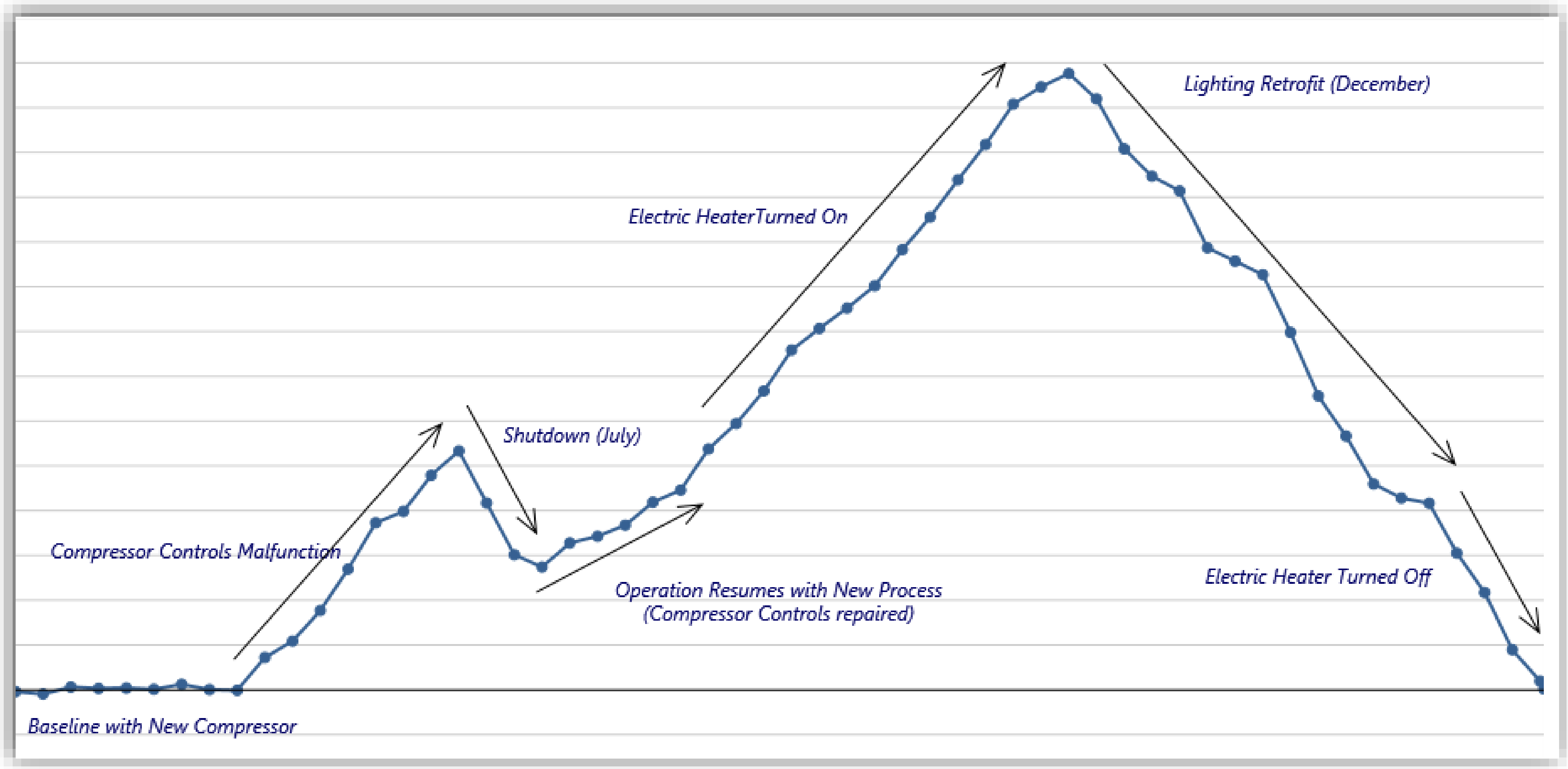




Significant Change in early 2021

# RETScreen Expert – Performance Analysis Tools



# Food Processing – Forgotten Attic Heaters



# Automotive – Idling Equipment on 3rd Shift

- LDC customer concerned with bill increase
- 2+ years of electricity data analyzed
  - Weather and production as drivers
- Initial analysis daily – weekly was best
- Beginning of “increase” traced back with CUSUM to a specific week.
- Operational mode change identified as cause
  - Not weather!
  - Increase in waster due to idle equipment
  - <u>Avoidable with new operational procedure</u>!
  - ~ 40,000 kWh per week

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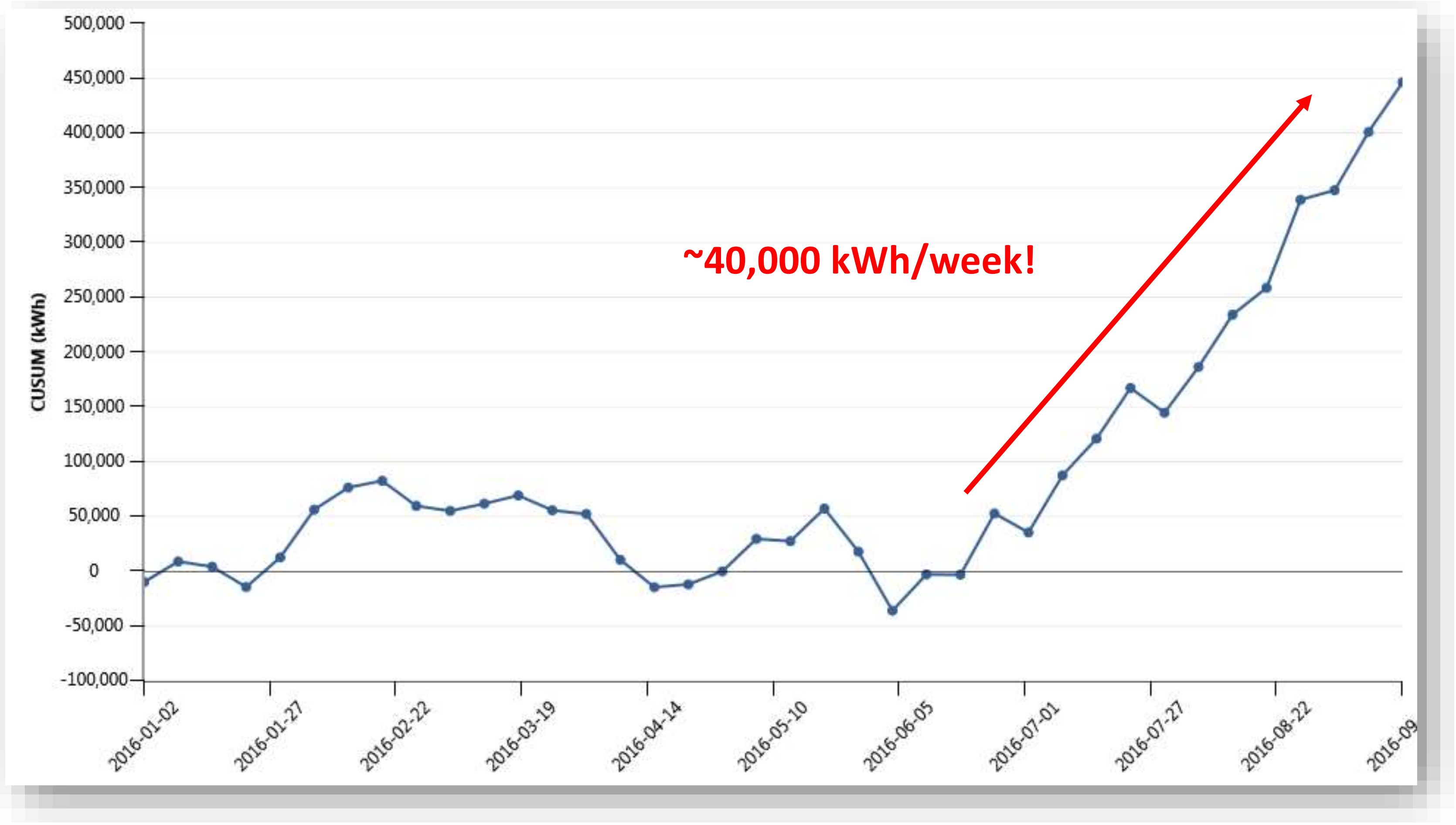
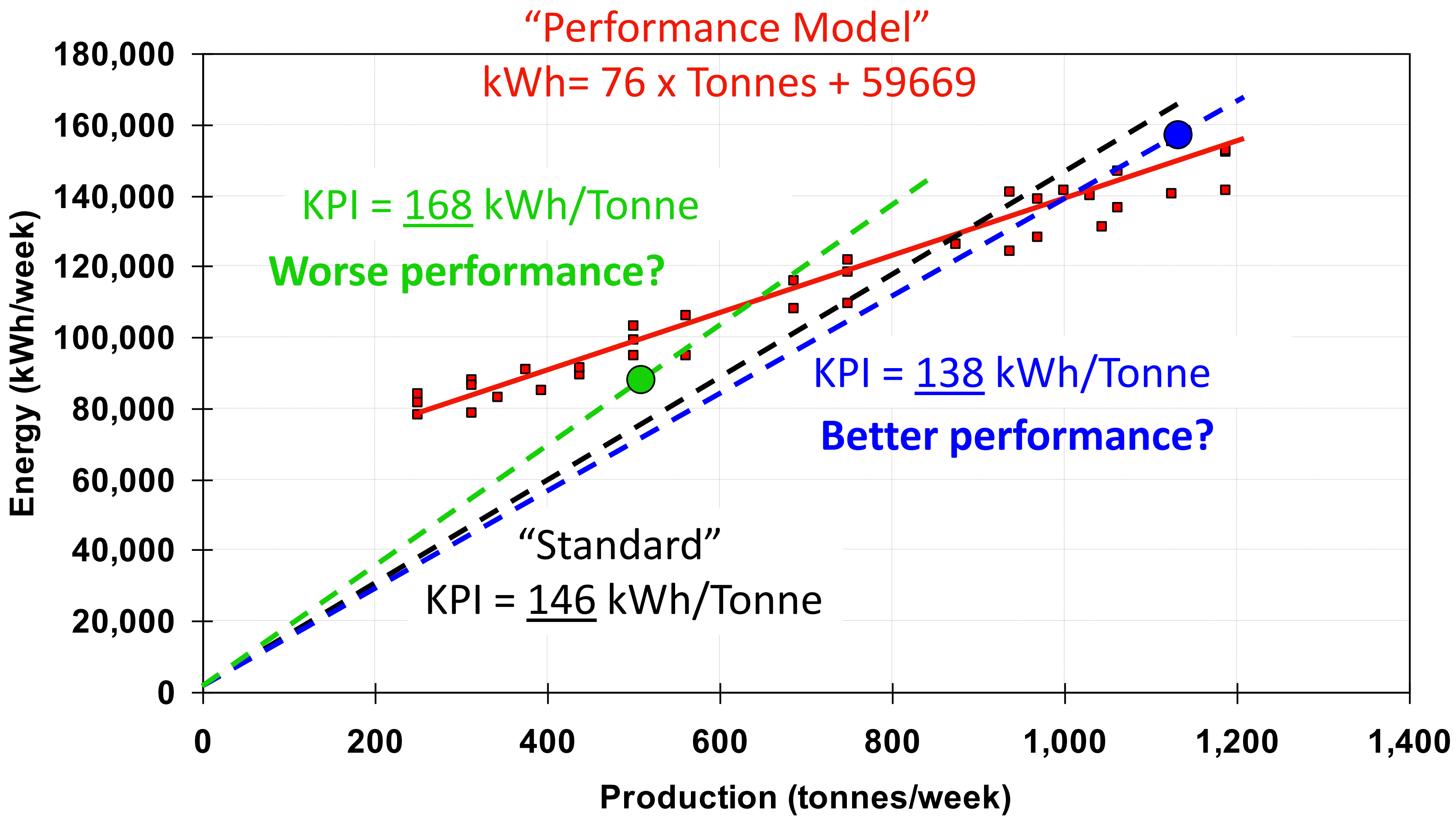
# High Bill Complaint < - > Production Scheduling



# A Caution: Energy KPIs vs Performance Models

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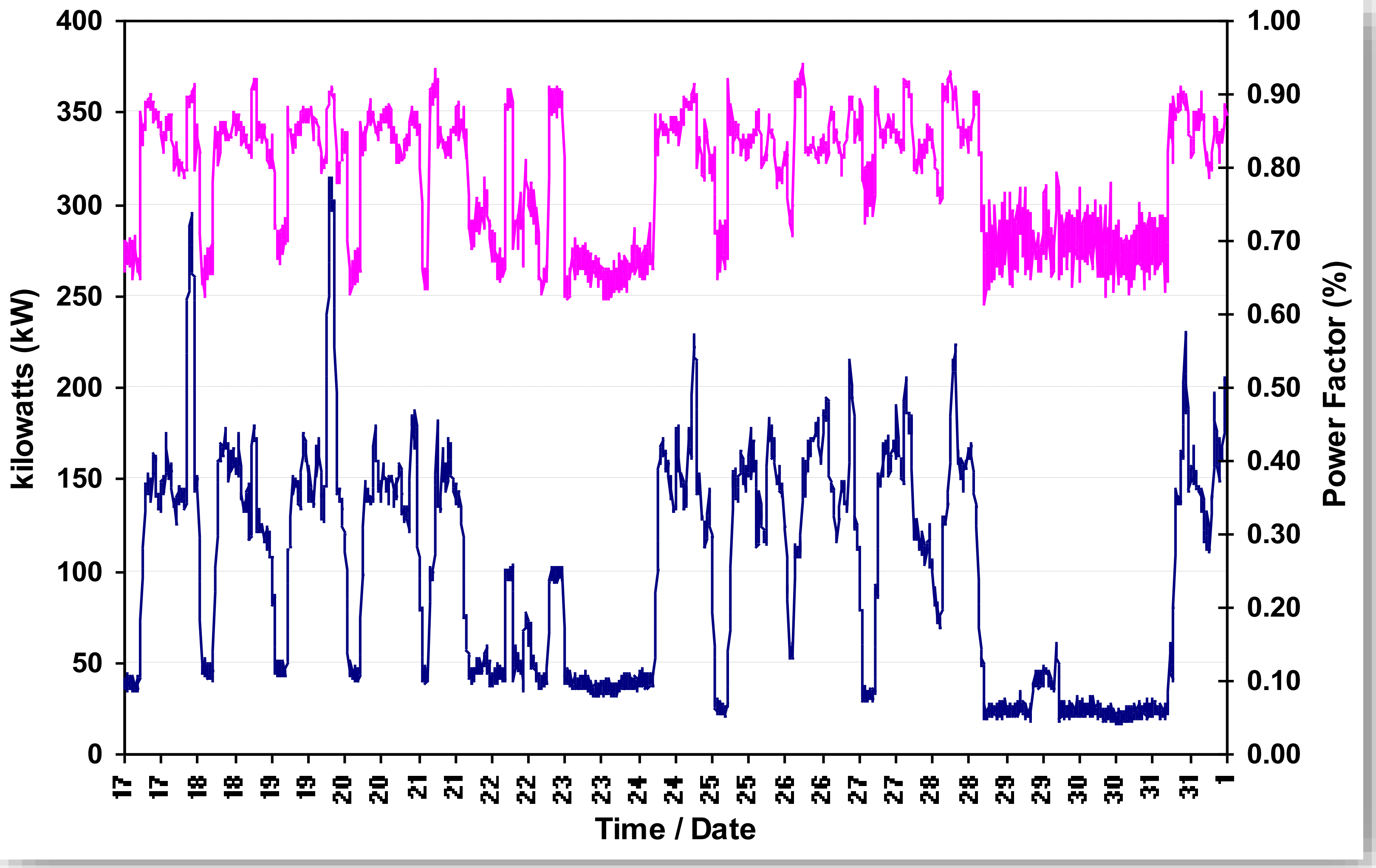
# Step 3: Understand When A Facility Uses Energy

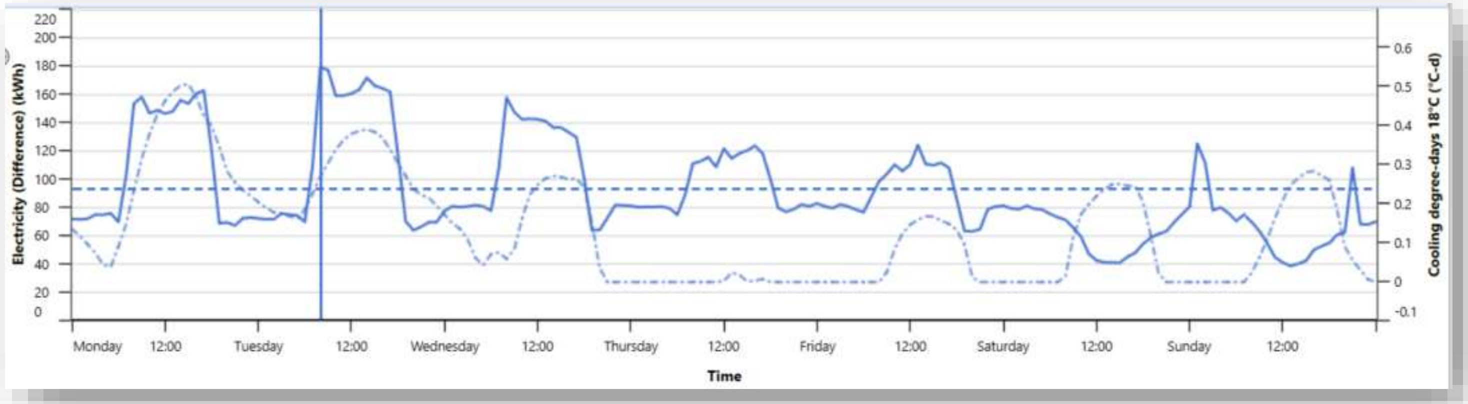


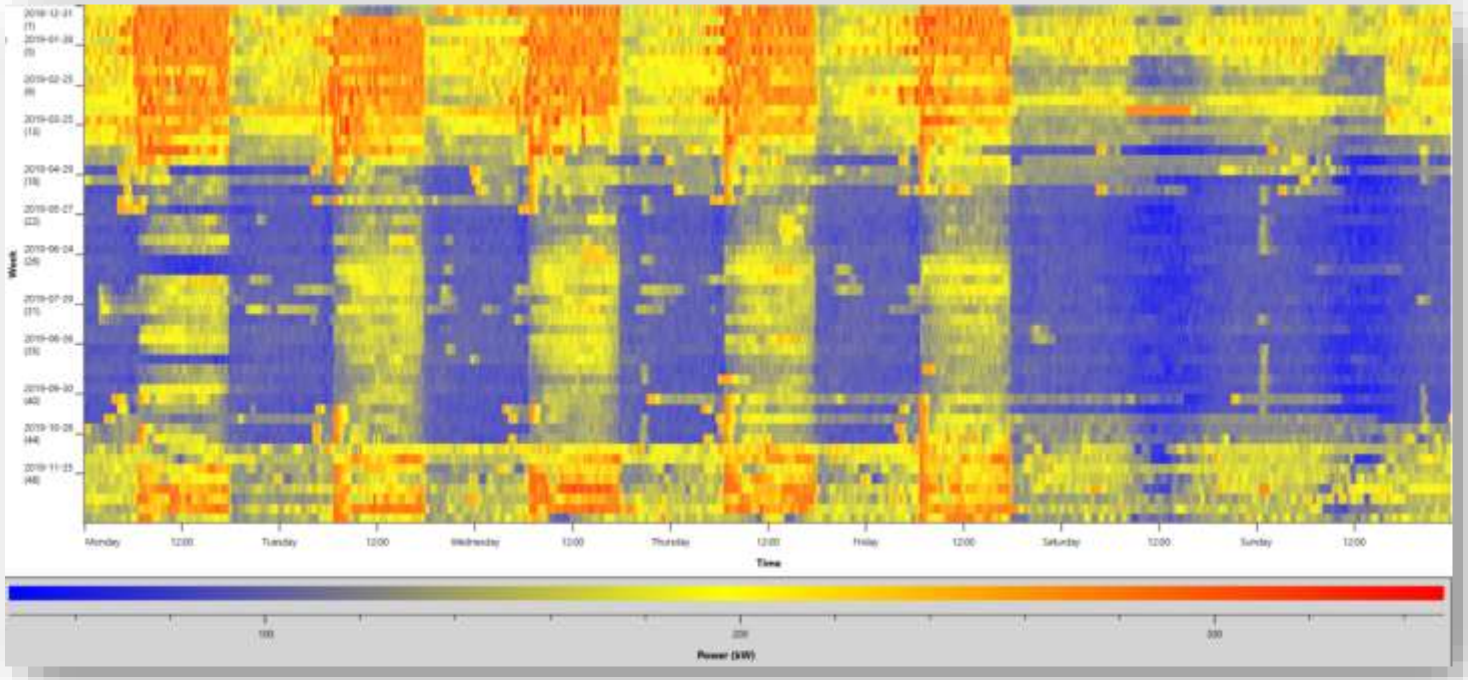

## Using kW & PF Information

- + kW - PF
  - Motor load on
- + kW +PF
  - Lighting load on
- - kW - PF
  - Lighting load off
- - kW + PF
  - Motor load off

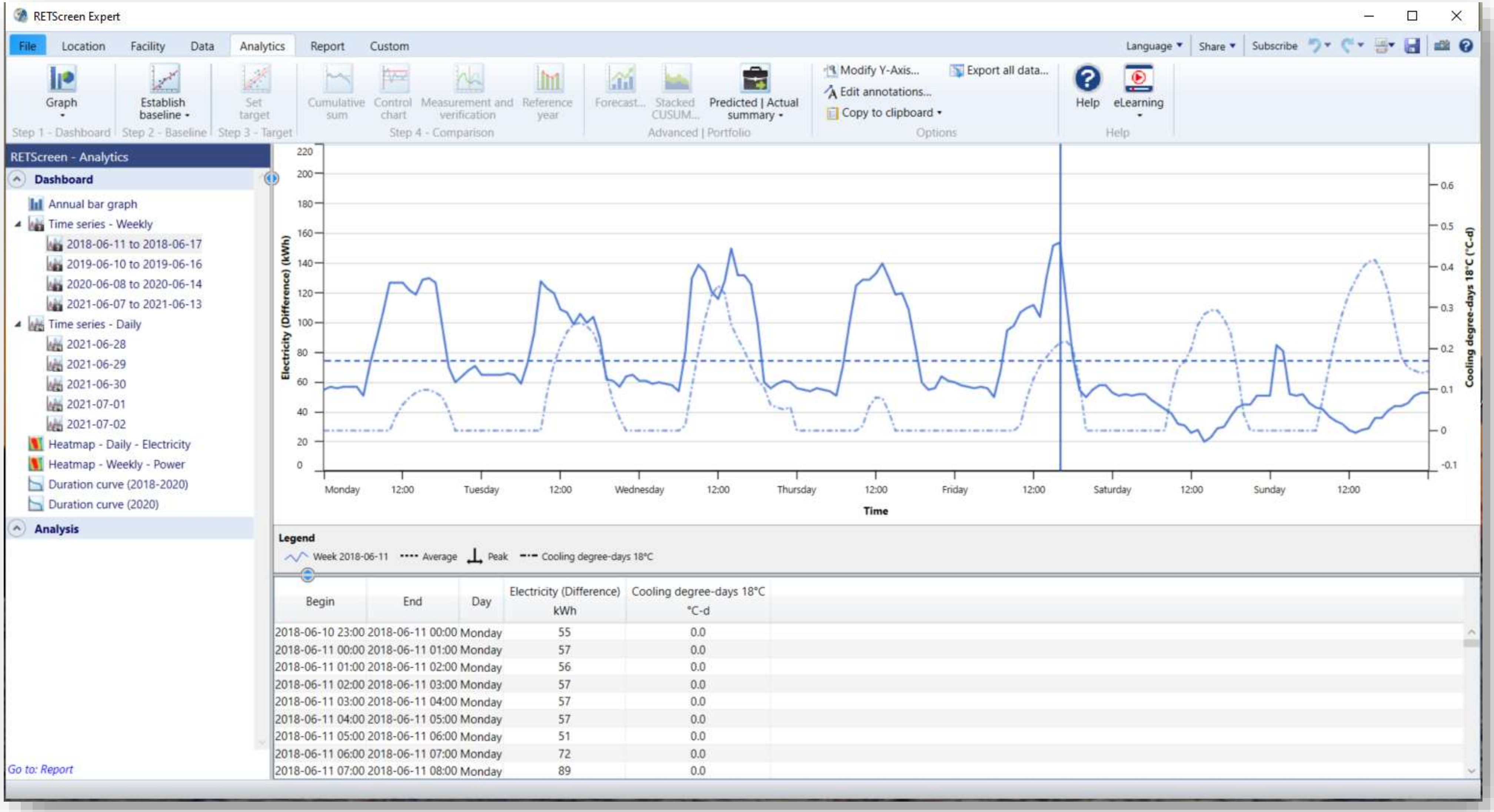
# Visualization of 15 Minute Electric Demand Data

| Begin | End | Duration Minutes | Electricity (Meter reading) kWh | Electricity (Difference) kWh | Power kW |
|---|---|---|---|---|---|
| 2017-12-31 23:45 | 2018-01-01 00:00 | 15 | 7,906,632 | | 207 |
| 2018-01-01 00:00 | 2018-01-01 00:15 | 15 | 7,906,674 | 42 | 207 |
| 2018-01-01 00:15 | 2018-01-01 00:30 | 15 | 7,906,725 | 51 | 251 |
| 2018-01-01 00:30 | 2018-01-01 00:45 | 15 | 7,906,772 | 47 | 239 |
| 2018-01-01 00:45 | 2018-01-01 01:00 | 15 | 7,906,810 | 39 | 215 |
| 2018-01-01 01:00 | 2018-01-01 01:15 | 15 | 7,906,859 | 49 | 233 |
| 2018-01-01 01:15 | 2018-01-01 01:30 | 15 | 7,906,906 | 47 | 221 |
| 2018-01-01 01:30 | 2018-01-01 01:45 | 15 | 7,906,944 | 38 | 208 |
| 2018-01-01 01:45 | 2018-01-01 02:00 | 15 | 7,906,993 | 49 | 257 |
| 2018-01-01 02:00 | 2018-01-01 02:15 | 15 | 7,907,039 | 46 | 246 |
| 2018-01-01 02:15 | 2018-01-01 02:30 | 15 | 7,907,077 | 38 | 199 |
| 2018-01-01 02:30 | 2018-01-01 02:45 | 15 | 7,907,123 | 46 | 227 |
| 2018-01-01 02:45 | 2018-01-01 03:00 | 15 | 7,907,170 | 48 | 220 |
| 2018-01-01 03:00 | 2018-01-01 03:15 | 15 | 7,907,206 | 36 | 174 |
| 2018-01-01 03:15 | 2018-01-01 03:30 | 15 | 7,907,251 | 46 | 250 |
| 2018-01-01 03:30 | 2018-01-01 03:45 | 15 | 7,907,296 | 45 | 209 |
| 2018-01-01 03:45 | 2018-01-01 04:00 | 15 | 7,907,335 | 39 | 195 |
| 2018-01-01 04:00 | 2018-01-01 04:15 | 15 | 7,907,376 | 42 | 215 |
| 2018-01-01 04:15 | 2018-01-01 04:30 | 15 | 7,907,424 | 48 | 231 |
| 2018-01-01 04:30 | 2018-01-01 04:45 | 15 | 7,907,461 | 37 | 183 |
| 2018-01-01 04:45 | 2018-01-01 05:00 | 15 | 7,907,504 | 43 | 227 |
| 2018-01-01 05:00 | 2018-01-01 05:15 | 15 | 7,907,552 | 48 | 224 |
| 2018-01-01 05:15 | 2018-01-01 05:30 | 15 | 7,907,594 | 43 | 212 |
| 2018-01-01 05:30 | 2018-01-01 05:45 | 15 | 7,907,632 | 38 | 207 |
| 2018-01-01 05:45 | 2018-01-01 06:00 | 15 | 7,907,683 | 51 | 258 |
| 2018-01-01 06:00 | 2018-01-01 06:15 | 15 | 7,907,727 | 44 | 211 |
| 2018-01-01 06:15 | 2018-01-01 06:30 | 15 | 7,907,767 | 40 | 200 |
| 2018-01-01 06:30 | 2018-01-01 06:45 | 15 | 7,907,819 | 53 | 257 |
| 2018-01-01 06:45 | 2018-01-01 07:00 | 15 | 7,907,878 | 59 | 296 |
| 2018-01-01 07:00 | 2018-01-01 07:15 | 15 | 7,907,929 | 51 | 245 |
| 2018-01-01 07:15 | 2018-01-01 07:30 | 15 | 7,907,980 | 51 | 240 |
| 2018-01-01 07:30 | 2018-01-01 07:45 | 15 | 7,908,035 | 56 | 276 |



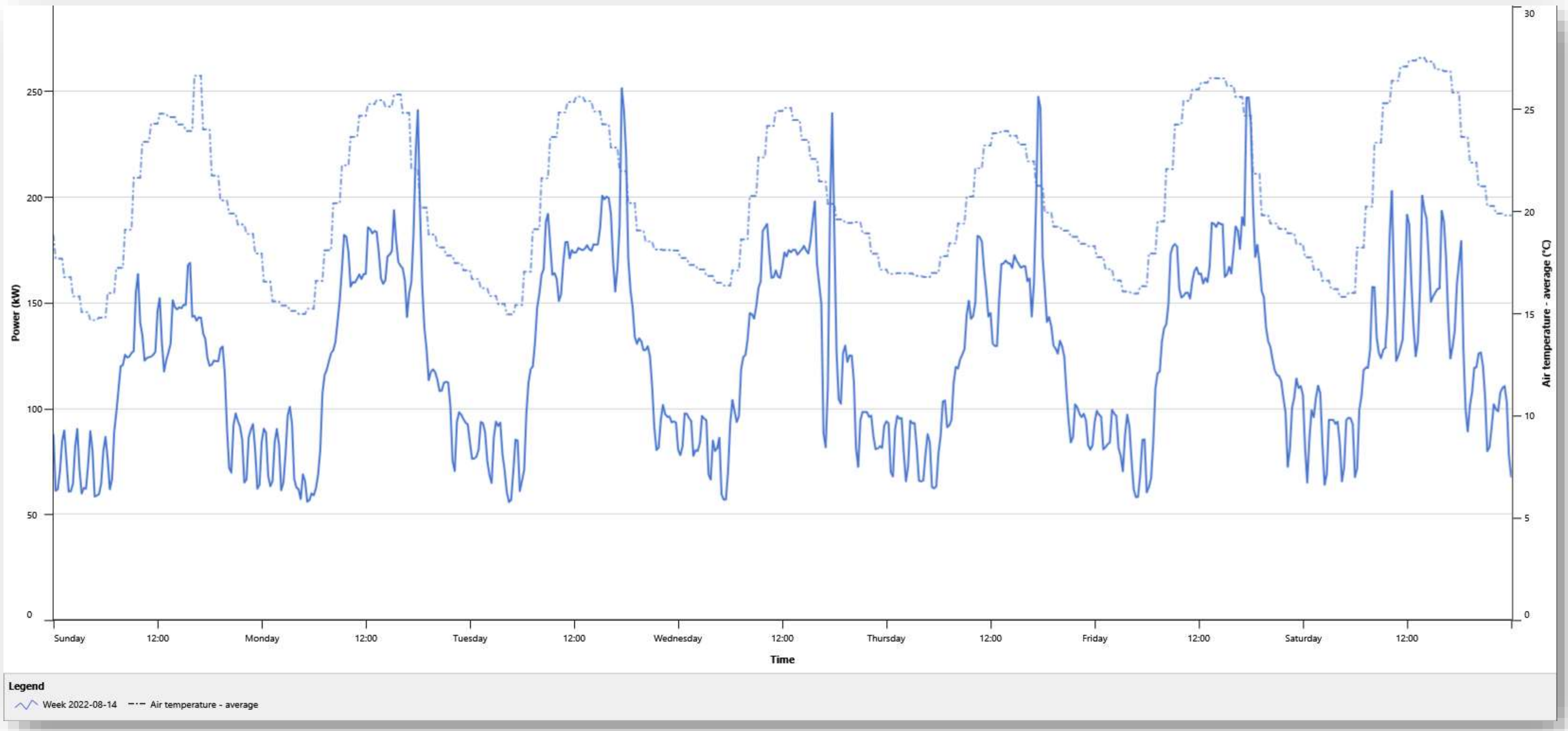



# Sub Daily Demand Profile – Always an Opportunity!

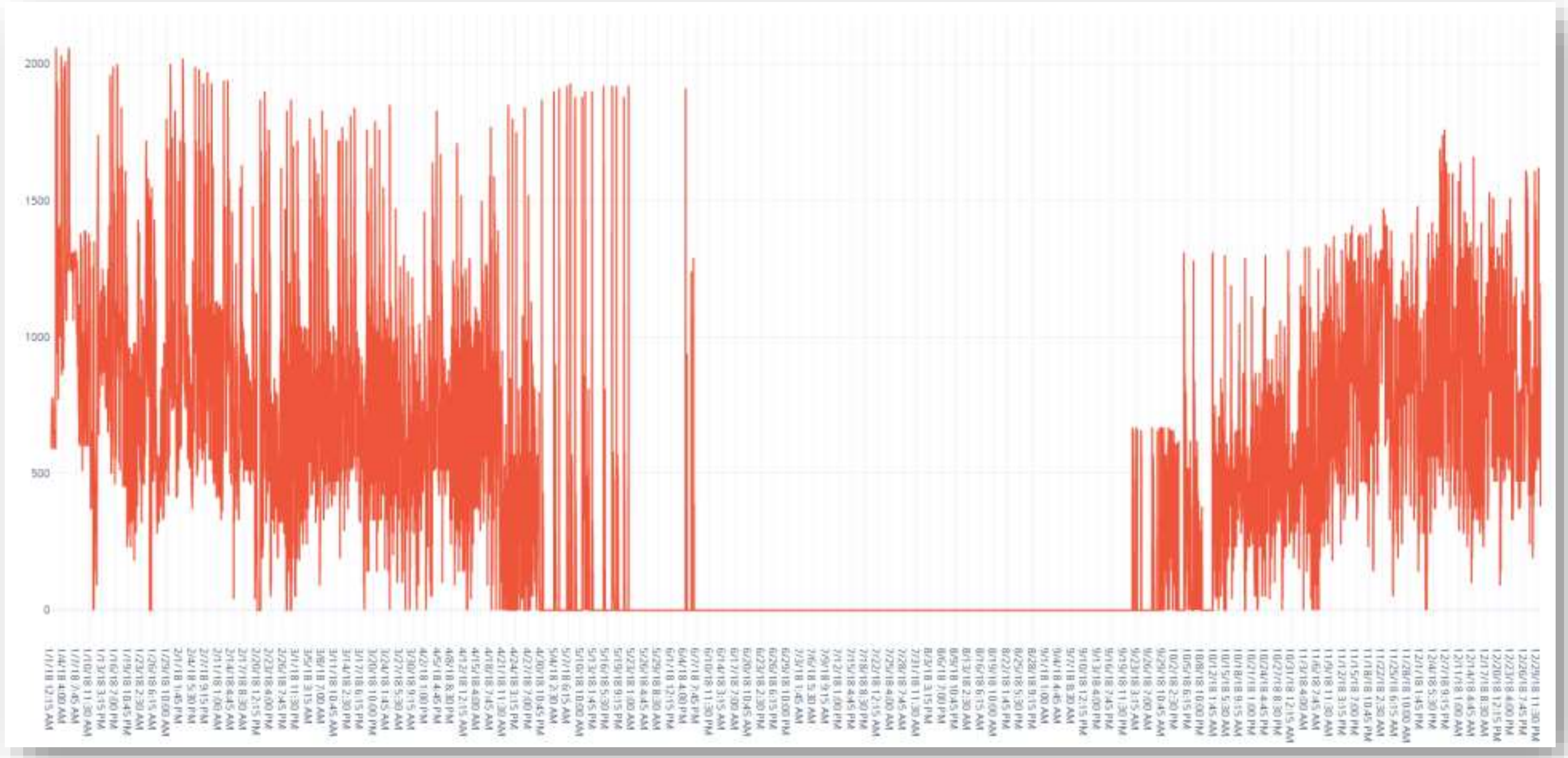



| Begin | End | Day | Electricity (Difference) kWh | Cooling degree-days 18°C °C-d |
|---|---|---|---|---|
| 2018-06-10 23:00 | 2018-06-11 00:00 | Monday | 55 | 0.0 |
| 2018-06-11 00:00 | 2018-06-11 01:00 | Monday | 57 | 0.0 |
| 2018-06-11 01:00 | 2018-06-11 02:00 | Monday | 56 | 0.0 |
| 2018-06-11 02:00 | 2018-06-11 03:00 | Monday | 57 | 0.0 |
| 2018-06-11 03:00 | 2018-06-11 04:00 | Monday | 57 | 0.0 |
| 2018-06-11 04:00 | 2018-06-11 05:00 | Monday | 57 | 0.0 |
| 2018-06-11 05:00 | 2018-06-11 06:00 | Monday | 51 | 0.0 |
| 2018-06-11 06:00 | 2018-06-11 07:00 | Monday | 72 | 0.0 |
| 2018-06-11 07:00 | 2018-06-11 08:00 | Monday | 89 | 0.0 |

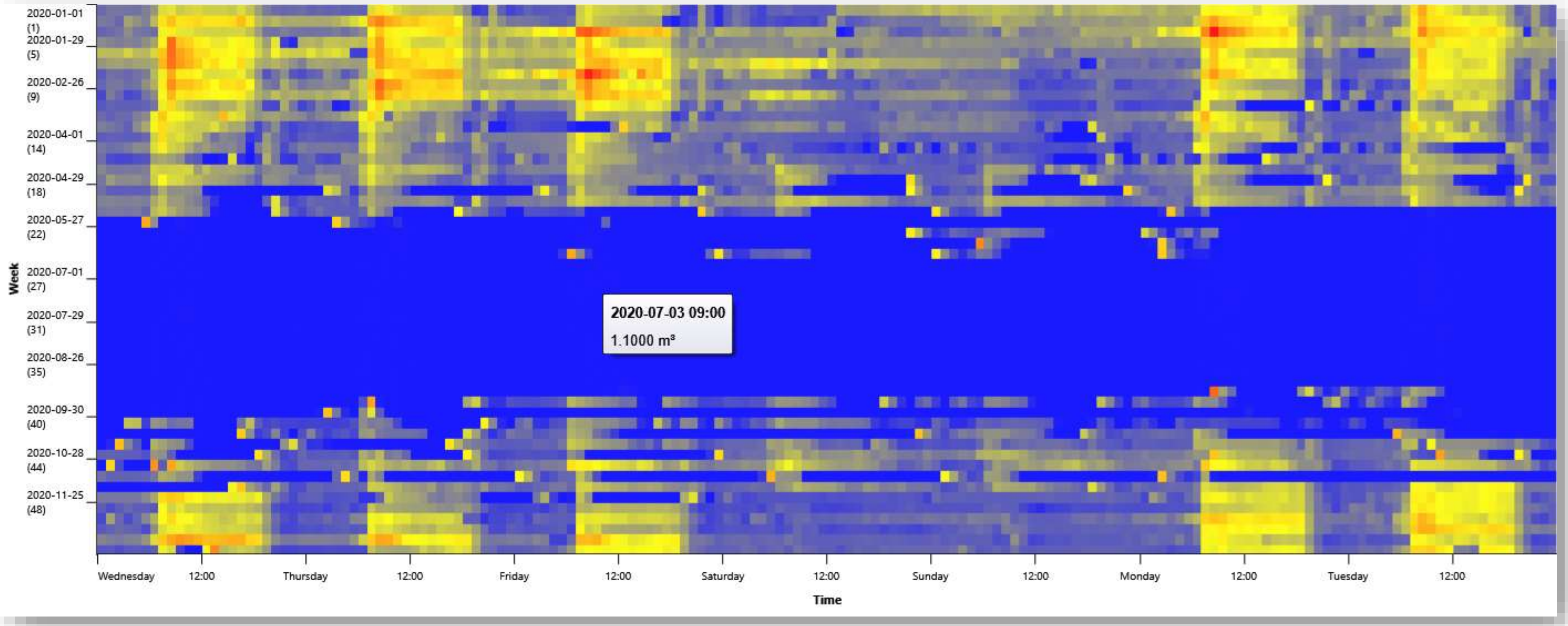
# Controls Issue Evident in a Facility Demand Profile



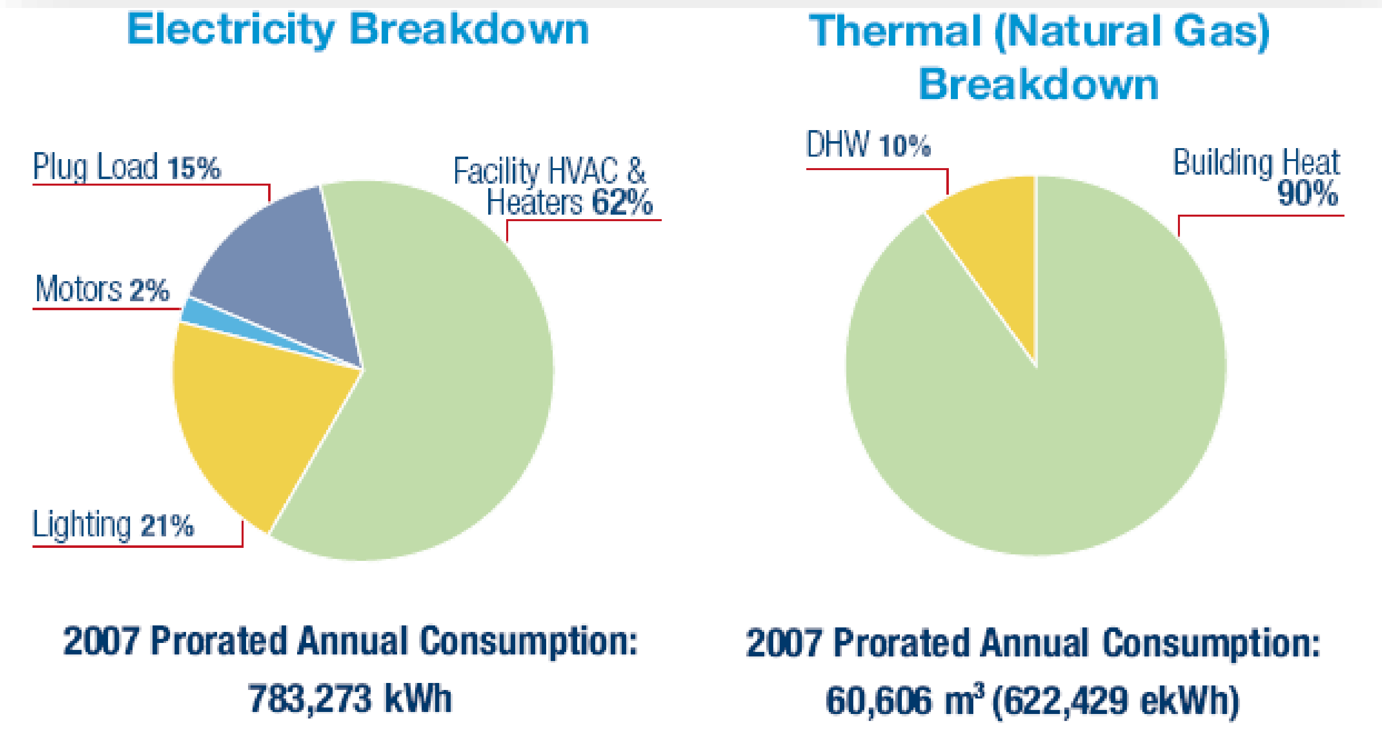
# Hourly Gas Plot Reveals Boiler Control Problems or Could be Used to Size Low Carbon Heating



# The Heat Map For Gas Data



# Step 4: Understand Where A Facility Uses Energy



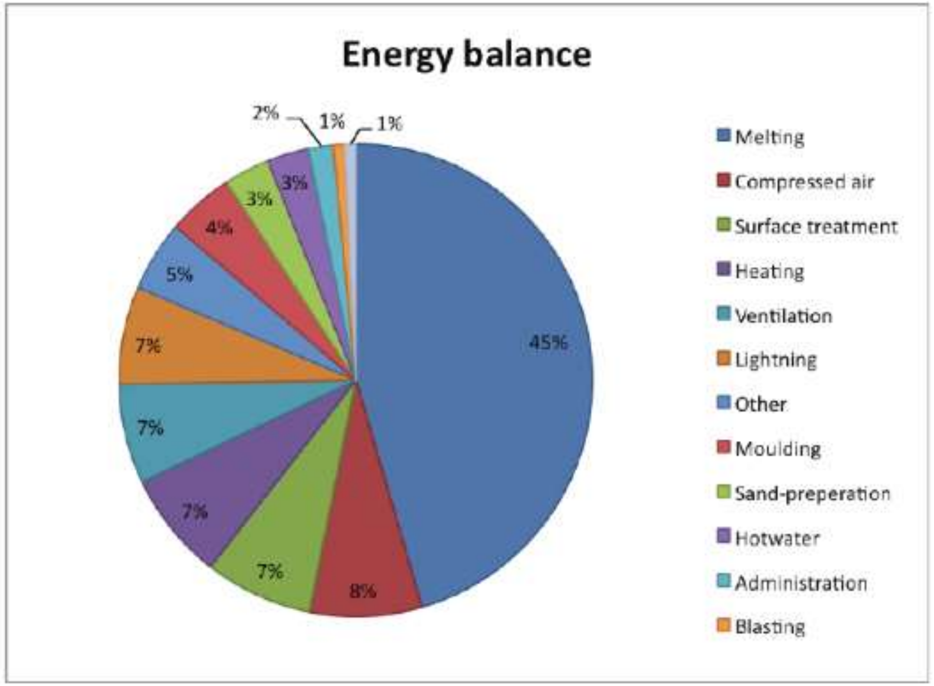



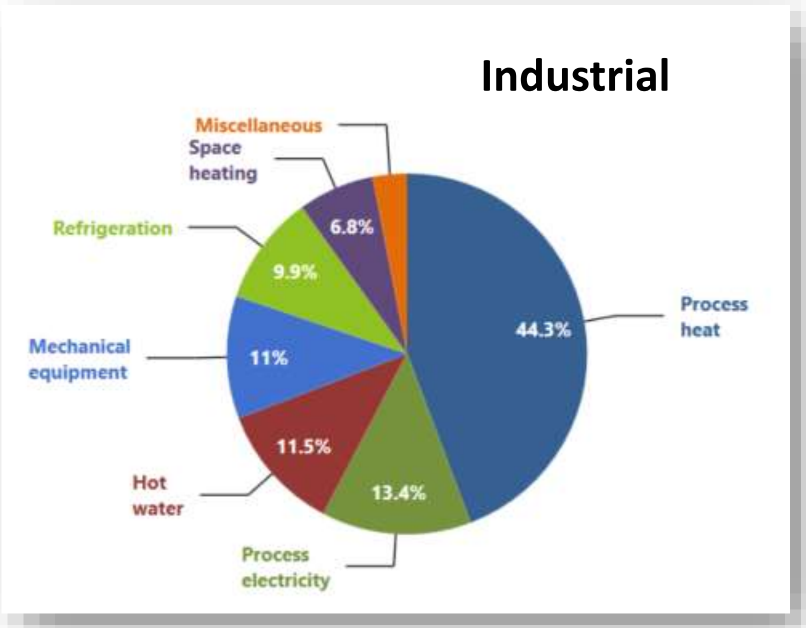

*Figure 2. Presents results from a typical energy audit in the Swedish foundry industry.*

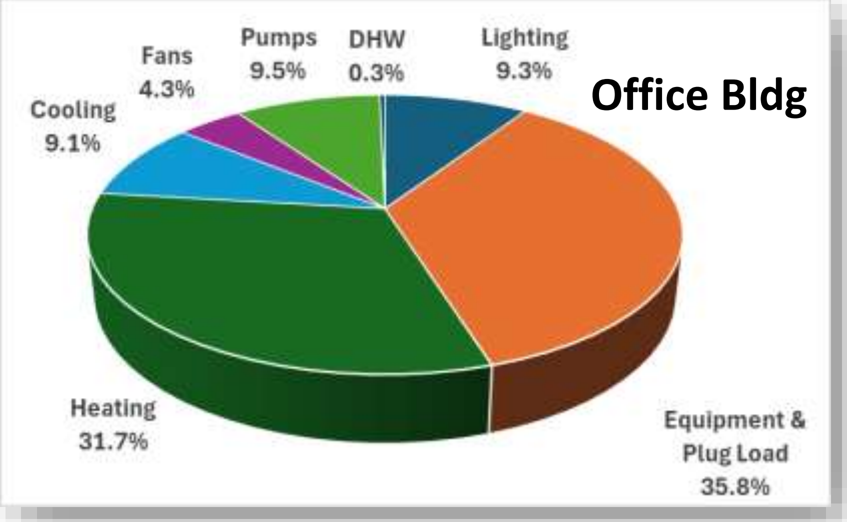
# RETScreen Expert Energy Breakdown

Food

Show: All
Fuel consumption - base case

| | Heating (kWh) | Cooling (kWh) | Electricity (kWh) | Incremental initial costs ($) | Fuel cost savings ($) | Incremental O&M savings ($) | Simple payback (yr) | Include measure? |
|---|---|---|---|---|---|---|---|---|
| **Pumps** | | | | | | | | |
| Mixer - Refrigeration | | | 20,491 | 0 | 2,049 | 0 | Immediate | ☑ |
| Spiral cooling conveyor | | | 32,718 | 0 | 0 | 0 | | ☑ |
| Cleaning-in-place | | | 374 | 0 | 0 | 0 | | ☑ |
| **Fans** | | | | | | | | |
| Office | | | 32,199 | 0 | 0 | 0 | | ☑ |
| Cafeteria | | | 4,563 | 0 | 0 | 0 | | ☑ |
| Warehouse | | | 27,293 | 0 | 0 | 0 | | ☑ |
| Manufacturing | | | 55,214 | 0 | 0 | 0 | | ☑ |
| Exhaust fan | | | 13,057 | 0 | 0 | 0 | | ☑ |
| Washroom | | | 3,853 | 0 | 0 | 0 | | ☑ |
| Air knife | | | 0 | 6,430 | -2,062 | 0 | None | ☑ |
| Shipping/Receiving - Air curtain | | | 0 | 1,320 | -32.7 | 0 | None | ☑ |
| **Process electricity** | | | | | | | | |
| Mixer | | | 756,864 | 600,000 | 49,669 | 900,000 | 0.6 | ☑ |
| Bread slicing machine | | | 63,072 | 0 | 0 | 0 | | ☑ |
| Automated packing line | | | 31,536 | 0 | 0 | 0 | | ☑ |
| Dough moulder | | | 84,096 | 0 | 0 | 0 | | ☑ |
| Spiral cooling conveyor | | | 72,270 | 0 | 0 | 0 | | ☑ |
| Freezer | | | 21,024 | 0 | 0 | 0 | | ☑ |
| Proofer | | | 55,188 | 600 | 3,942 | 0 | 0.2 | ☑ |
| Tunnel baking oven | | | 13,140 | 0 | 0 | 0 | | ☑ |
| Conveyor | | | 43,800 | 0 | 0 | 0 | | ☑ |
| Vacuum lifter | | | 972 | 0 | 0 | 0 | | ☑ |
| Forklift truck - Charging station | | | 20,023 | 0 | 0 | 0 | | ☑ |
| **Process heat** | | | | | | | | |
| Proofer | 59,130 | | | 0 | 0 | 0 | | ☑ |
| Tunnel baking oven | 2,838,240 | | | 4,500 | 20,029 | 0 | 0.2 | ☑ |
| Volatile organic compounds (VOCs) - Control | 109,500 | | | 0 | 0 | 0 | | ☑ |
| **Process steam** | | | | | | | | |
| Proofer | 700,300 | | | 0 | 0 | 0 | | ☑ |
| Cleaning-in-place | 116,717 | | | 0 | 0 | 0 | | ☑ |
| **Heat recovery** | | | | | | | | |
| Tunnel baking oven | 0 | 0 | | 32,000 | 16,794 | 0 | 1.9 | ☑ |
| **Compressed air** | | | | | | | | |
| Compressed air | | | 762,356 | 23,980 | 65,344 | 0 | 0.4 | ☑ |
| **Refrigeration** | | | | | | | | |
| Mixer | | 613,200 | | 0 | 61,320 | 0 | Immediate | ☑ |
| Spiral cooling conveyor | | 204,400 | | 0 | 0 | 0 | | ☑ |
| Cooler - Walk-in | | 8,760 | | 0 | 0 | 0 | | ☑ |
| Freezer - Walk-in | | 27,594 | | 0 | 0 | 0 | | ☑ |

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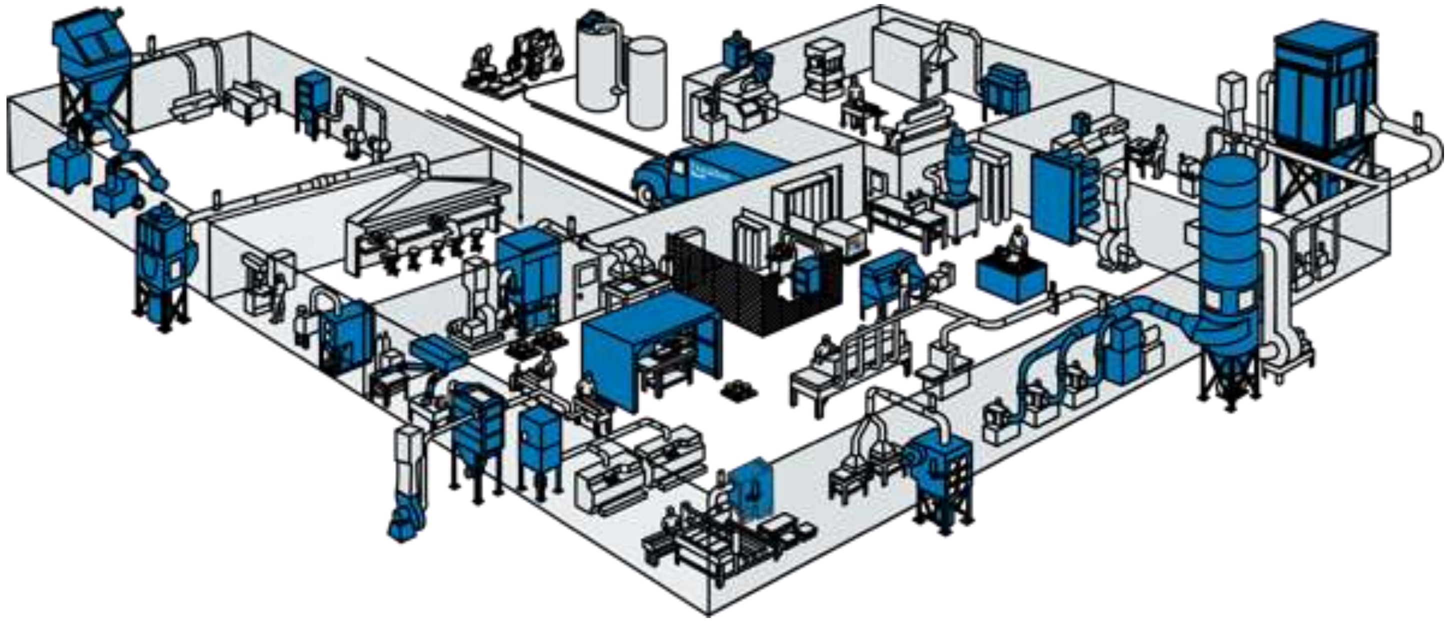
# Understanding Where

- Assuming vast majority of energy is used for a production process may miss opportunities in the supporting systems.

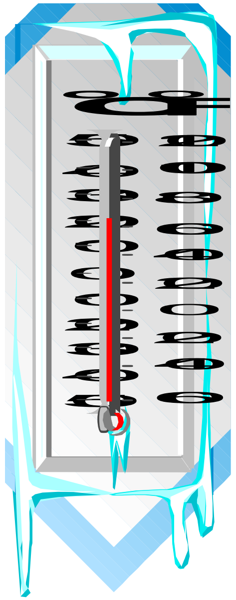


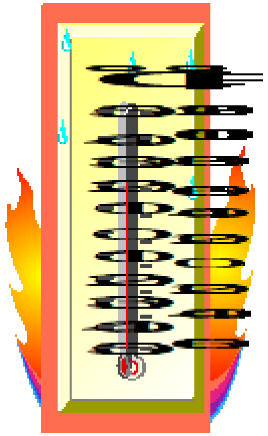
# Steps 5, 6 & 7 – Identify the Opportunity

1. Understand Consumption Price & Cost
2. Compare Yourself to Benchmarks
3. Understand When Your Building Uses Energy
4. Understand Where Your Building Uses Energy
5. Eliminate Energy Waste
6. Improve Efficiency
7. Optimize Energy Supply

# Establish a Valid Need

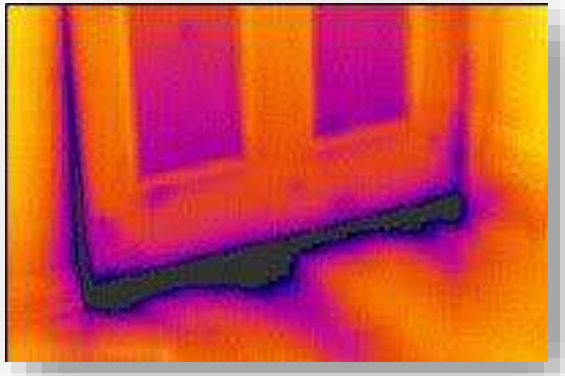
- Heat/Cool
- Air Power
- Fluid Flow
- Ventilation
- Illumination
- Process Heat
- Process Cooling
- Compressed Air



# 5. Eliminate Energy Waste
# "Match the Need – Right Size"

- Turn it off
  - Lights, fans, pumps
  - Leaky building envelope
  - Compressed air / vacuum leaks
  - Steam traps
  - Phantom loads
- Turn it down
  - Temperature
  - Water
  - Air flow
- Control it
  - Exhaust / ventilation
  - Lighting time & levels



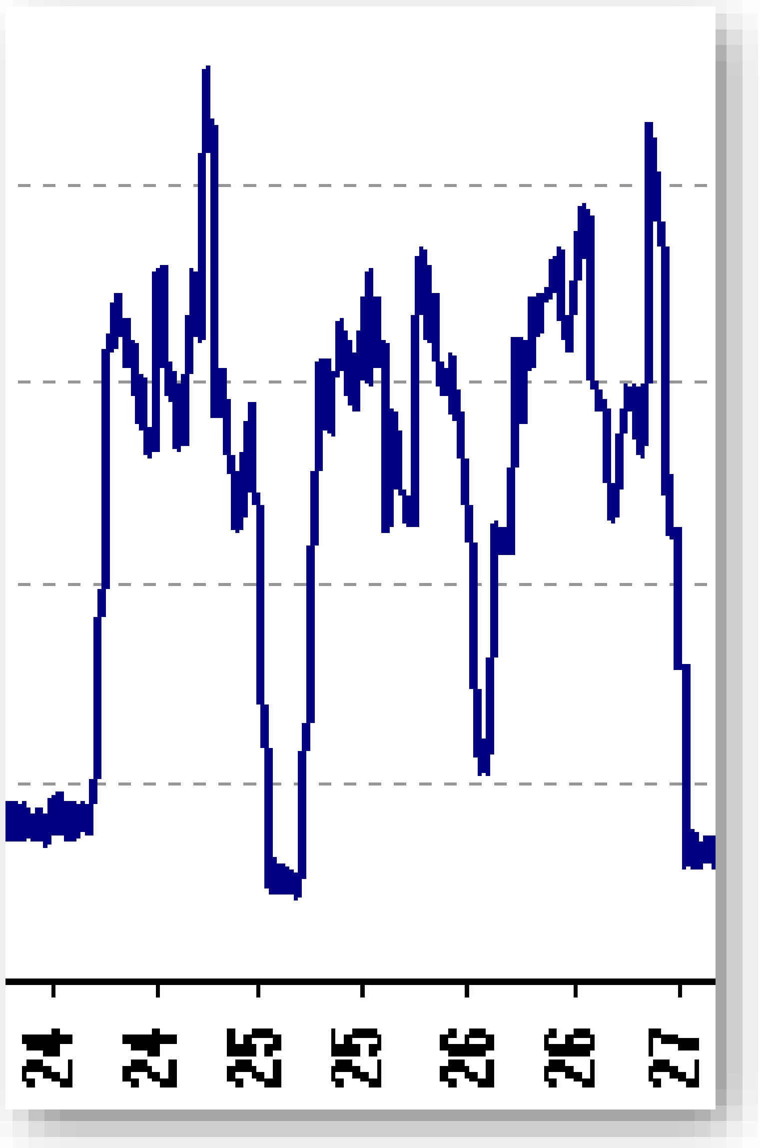
# Industrial Reduce Compressed Air Leaks

- Metering of compressors and ultrasonic leak testing revealed 200 scfm = 50 HP
- Where: piping connections, control valves, drains.
- Savings : 343,000 kWh per year
- Savings : $30,870 per year
- Payback: < 1 year.

https://www.caasafety.com.au/products/ultrasonic-leak-detector/

# Peak Demand Reduction

- Food processing facility
- 60 HP Air Compressor that cycles on due to short term demand not being buffered by receiver.
- Savings : 50 kW, 0 kWh
- Savings : $6,100 per year
- Payback linked to compressor control system improvements.



# Manufacturing: Reduce Non-Productive Electricity

- From profile 400-450 kW during non-productive times – est. 75kW reduction.
- Housekeeping Manager's walk around list
  - Lighting, pumps, exhaust & cooling fans, computers, chillers, mixers, etc.
- Savings : $18,000 per year
- Shut-down list procedure required.
- Payback: immediate

# Significant Waste

- Reduce speed of 150 HP glycol pump to ~ 80%, 24/7.
  - VSD exists – currently used at night
- Requires testing to determine the best operating point for the system
- Electricity savings: ~ 300,000 kWh
  - 9 tonnes of $CO_{2e}$
- Cost Reduction: ~ $55,000
  - Including peak demand impacts
- Reduced pump maintenance
  - Non energy benefit

# Step 6: Maximize Efficiency

- Maintenance
  - Filters and lubrication
  - Clean heat exchangers, pipes, ducts and coils
- Combustion Equipment
  - Regular tune-ups
  - New controls
- Optimize compressors, pumps and fans
  - Sequence multiple devices
  - Operate at most efficient point.
  - Variable speed drives
- More efficient equipment
  - Lighting
    - Lamps &/or re-design
  - Compressors & Chillers

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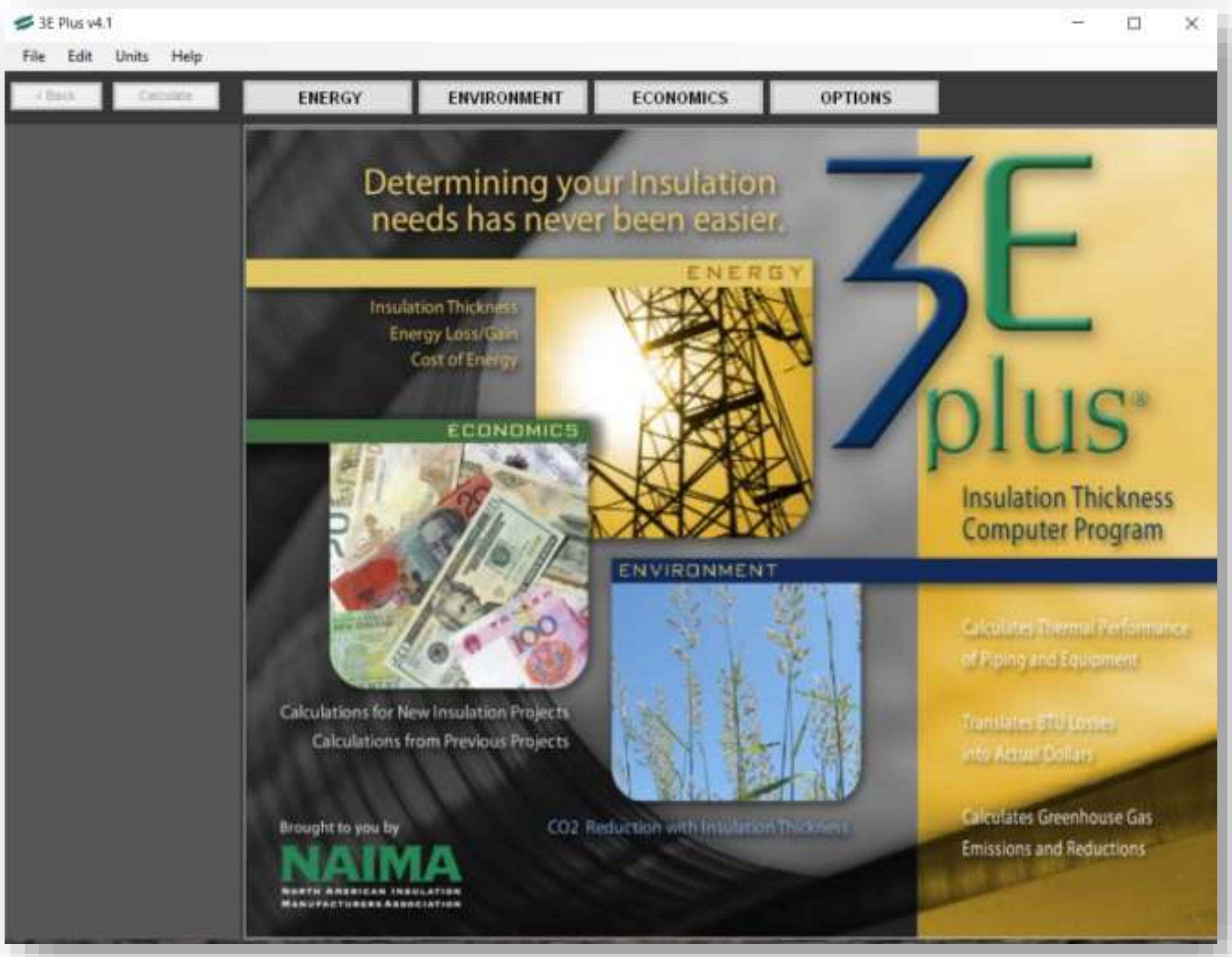
# Industrial: Improve Pipe Insulation

- 10% of piping system (100ft approx) un-insulated at 7psi steam pressure
- Insulate 2" distributions with 50mm overcoat
- Savings : 41,000 m3 gas per year
- Savings : $21,000 per year


https://blog.thermaxxjackets.com/industrial-pipe-insulation

# 3E Plus – Savings from Insulation



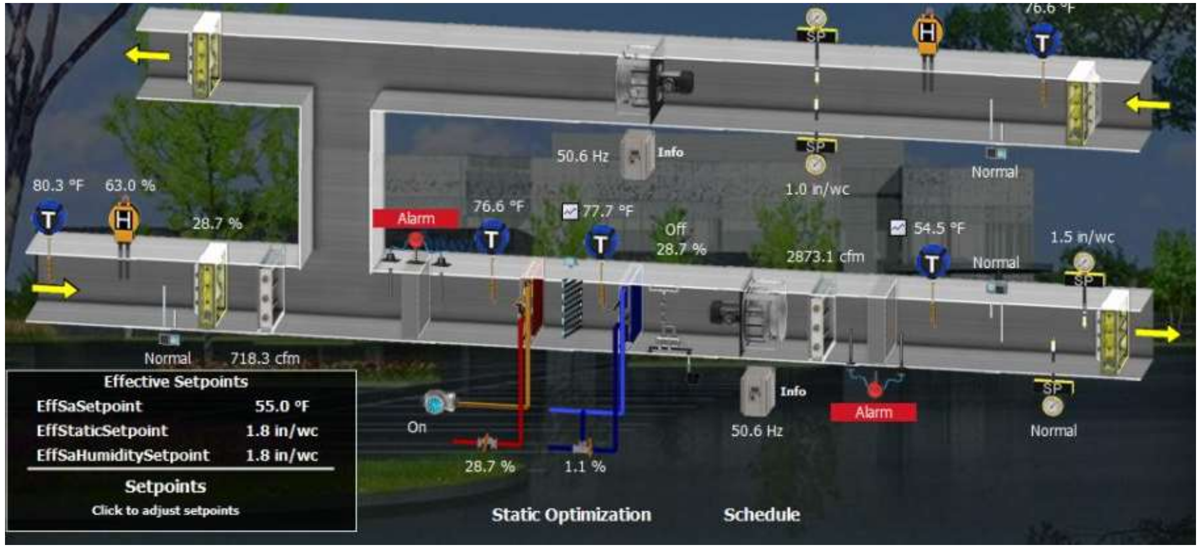

https://insulationinstitute.org/tools-resources/free-3e-plus/

# Improve Compressed Air System Control

- Incorporate larger receiver capacity, variable speed compressor, and controls.
- Variable speed compressor could be an alternative to rebuild 2 existing compressors .
- Savings : $8,200 per year.
- Payback: 1-2 years depending options.

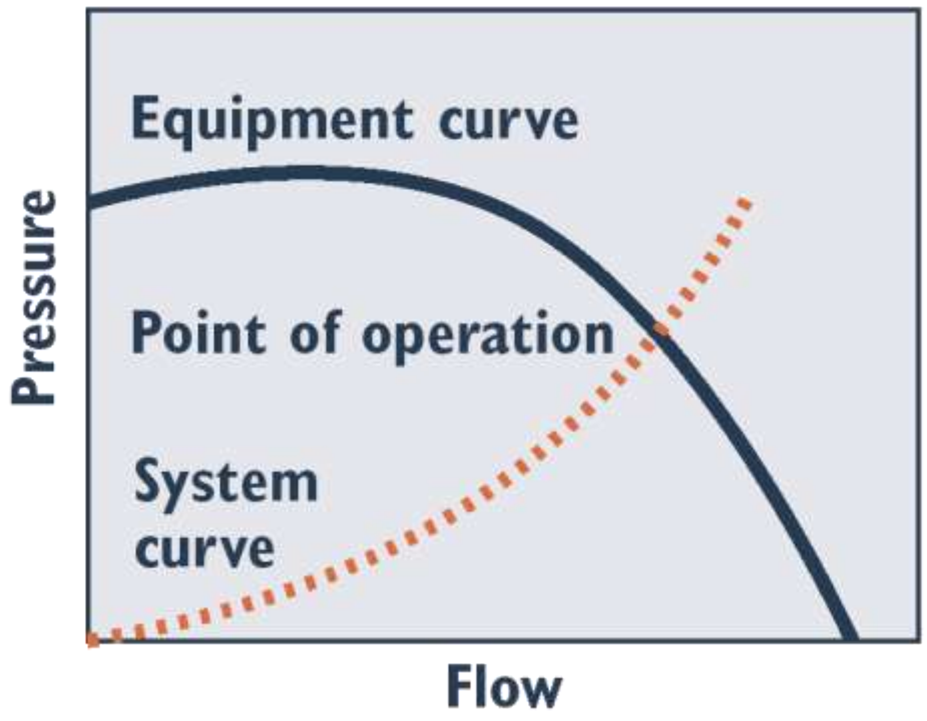
# Treasure Hunt Example –
# Modulate AHU Fan Speed w/VFD

- Add VFDs to AHU to modulate fan speed based on load (temperature)
- Run at 90% winter
- Stop on weekends
  - Start on demand to 75%
- Run at 75%
  - Evening
  - Early start-ups
- Elec 153,000 kWh
- **$18,400/yr**




https://hvac-talk.com/vbb/threads/1911151-HVAC-Graphics-Library

# Pump & Fan Basic Principles



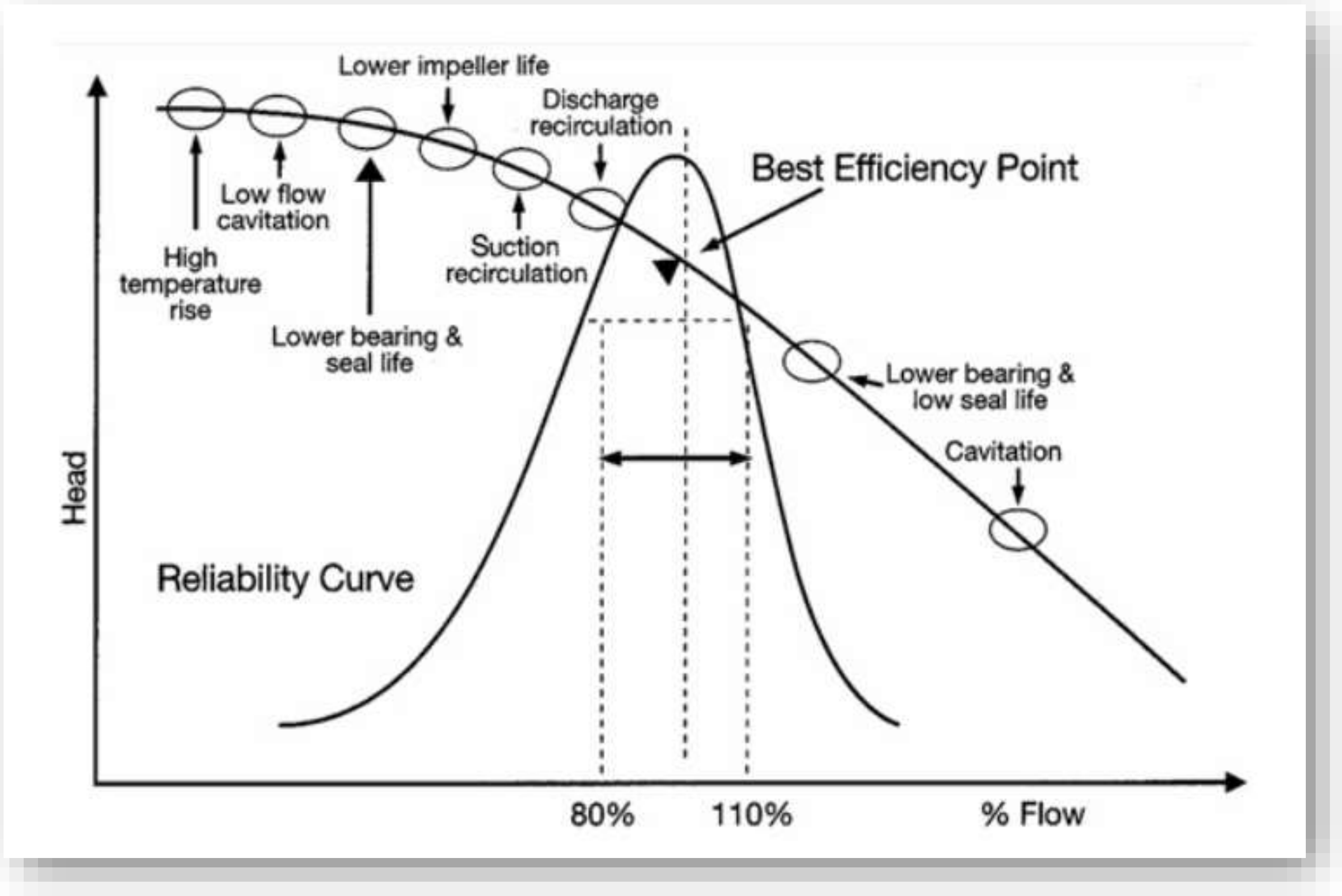

In general:
Power = Flow x ΔPressure
kW = Q x ΔP

$$\frac{Q_2}{Q_1} = \frac{N_2}{N_1} \qquad \frac{P_2}{P_1} = \left(\frac{N_2}{N_1}\right)^2 \qquad \frac{kW_2}{kW_1} = \left(\frac{N_2}{N_1}\right)^3$$

Affinity laws for centrifugal fans and pumps

***N*** = speed, ***Q*** = flow, ***P*** = pressure, ***kW*** = power

# Pump Reliability: Flow & Efficiency




Source: https://blog.craneengineering.net/pump-performance-curves-reliability

# Pumping System Demonstration

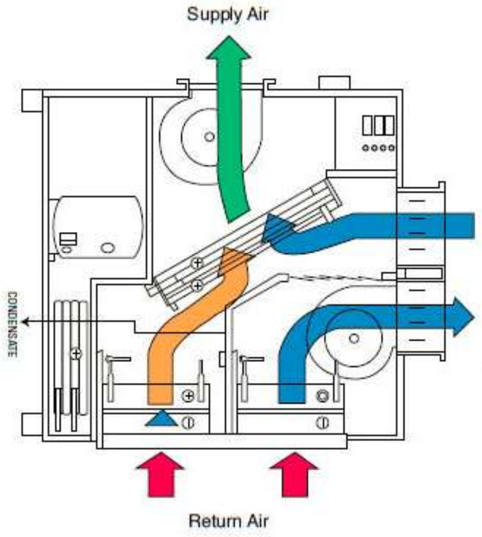
# Back to the 7th & Final Step!

1. Understand Consumption Price & Cost
2. Compare Yourself to Benchmarks
3. Understand When Your Building Uses Energy
4. Understand Where Your Building Uses Energy
5. Eliminate Energy Waste
6. Improve Efficiency
7. Optimize Energy Supply

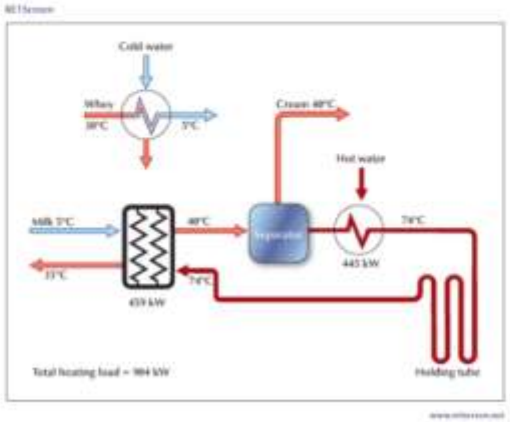
# 7: Optimize Supply

## After reducing waste & increasing efficiency

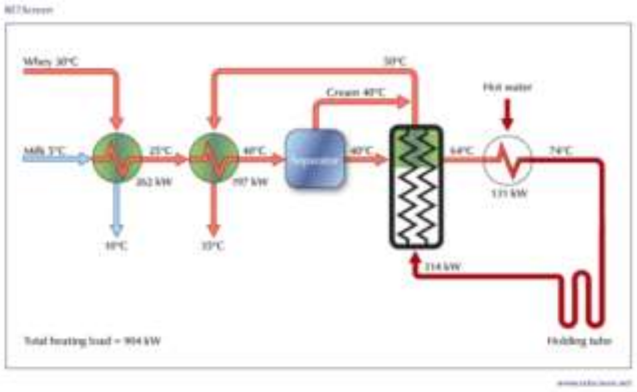
- Heat Recovery
  - Water, air, process effluents
  - Improve existing performance
- Heat pumps
  - Ground & air source
  - Heat recovery
- Renewable energy
  - Photovoltaic
  - Solar air, hot water
  - Wind power



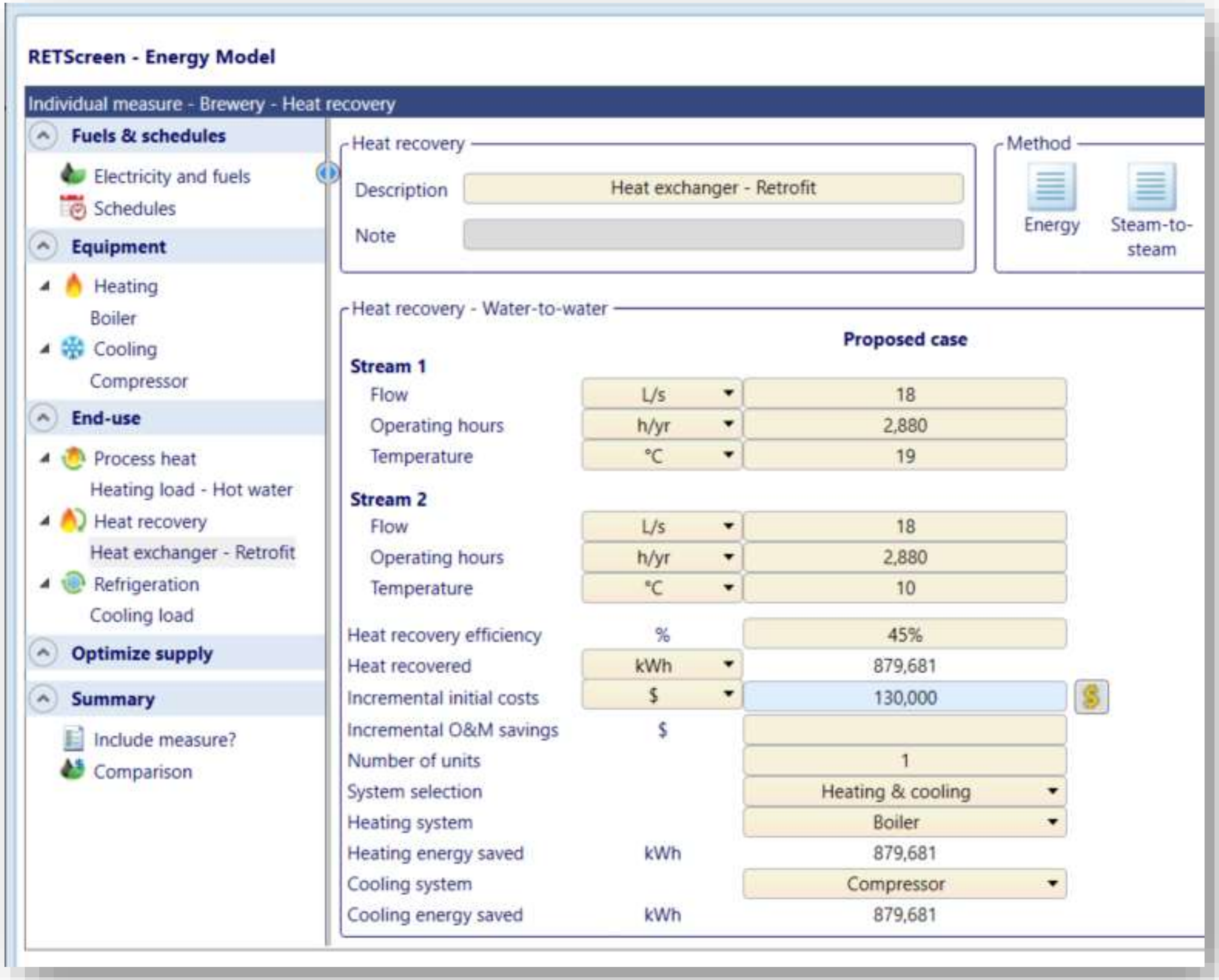

# Heat Recovery Tools in RETScreen



Base case



Proposed case



# Finally, What Will Your Crack Patrol Look Like?

https://www.youtube.com/watch?v=n3_BC-FBo5g&t=1s

# Critical Questioning Checklist

- Can you shut if off?
  - Or turn it down, or control it better
- Can you tune it up?
- Can you make it routine?
  - Find better practices
- Can you make an investment in it?
  - A lot of incentives/rebates are  available

## Finding Opportunities with 4 Basic Questions

| Questions | Opportunity to Save |
|---|---|
| **Can I shut it off?**<br><br>Are there systems or equipment operating during times when they are not required and you could shut them down?<br><br>*Example: electric sidewalk heater in late spring* | |
| **Can it be tuned up?**<br><br>Are there pieces of equipment that need regular check-ups or adjustments to ensure better efficiency.<br><br>*Example: small gas fired DHW heater.* | |

| | |
|---|---|
| **Can I make it routine?**<br><br>Are there items that maybe small or large but tend to get forgotten in the everyday rush of keeping other things operating properly. Can I add them to a checklist or procedure?<br><br>*Example: cleaning/changing of an air intake filter on a boiler or compressor.* | |
| **Can invest in it and use a rebate?**<br><br>Is there older equipment that needs replacing or is far less efficient than newer equipment. Is there a rebate from SaveOnEnergy or Enbridge?<br><br>*Example: Older T12 or T8 lighting in service areas.* | |

List Compiled by: ______________________________

# The Help Desk for Workshop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