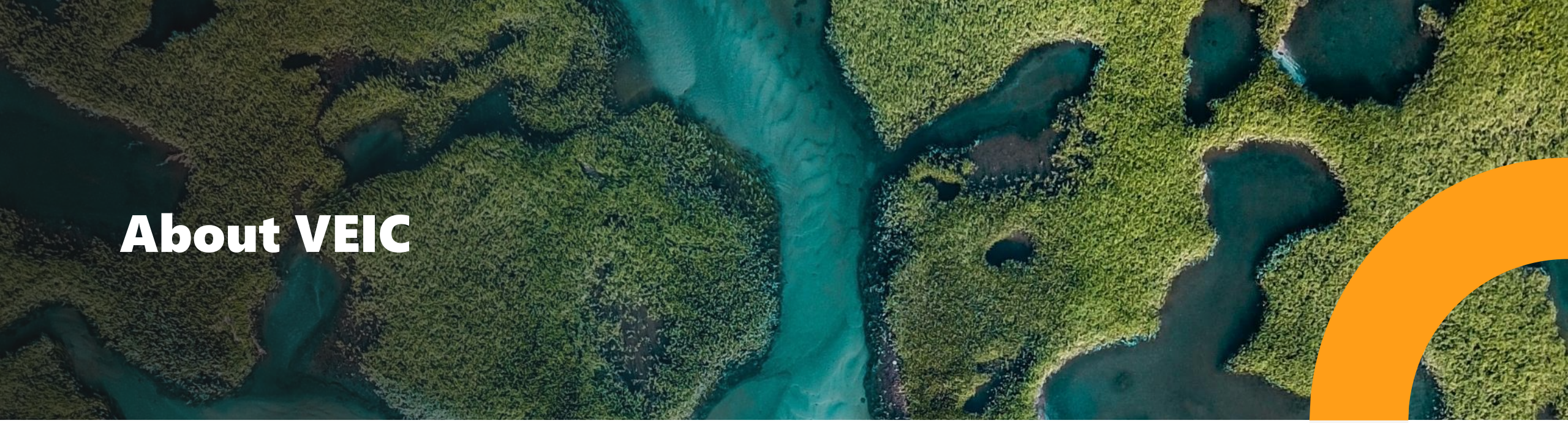
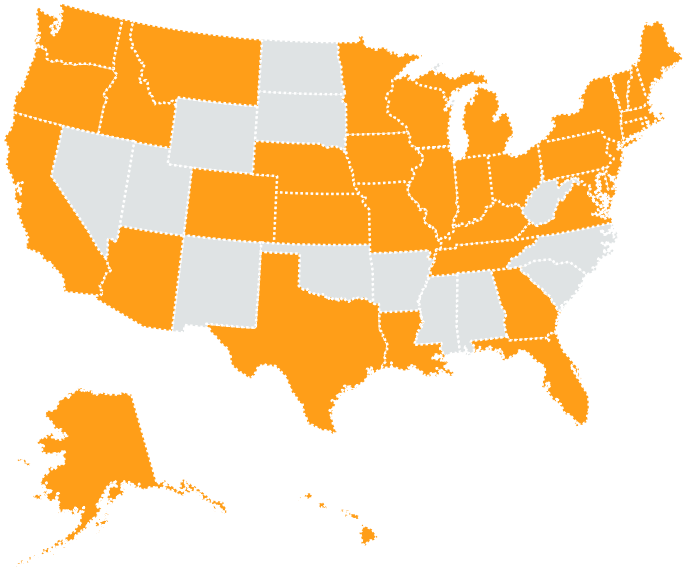
VEIC Training Series

# Refrigeration: Programs that Deliver Environmental, Economic and Health Benefits

May 15, 2020



# About VEIC



## We're on a mission to generate the energy solutions the world needs.

VEIC works with organizations across the energy landscape to create immediate and lasting change. Since 1986, we've served as an objective partner for our clients as they navigate complex energy challenges. With expertise in energy efficiency, building and transportation electrification, and new approaches for a clean and flexible grid, we bring new solutions to the market that meet goals and make change.

veic

**Together with our clients, we've been delivering customized trainings to the market to build expertise and drive value with end-use customers.**

# Our experts

**Ethan Bellavance**

Senior Energy Consultant, Engineer

**Nicole Duquette**

Energy Consultant, Engineer

**Ali White**

Energy Consultant, Engineer

# What we'll cover

## Why Refrigeration?

What are the Benefits?

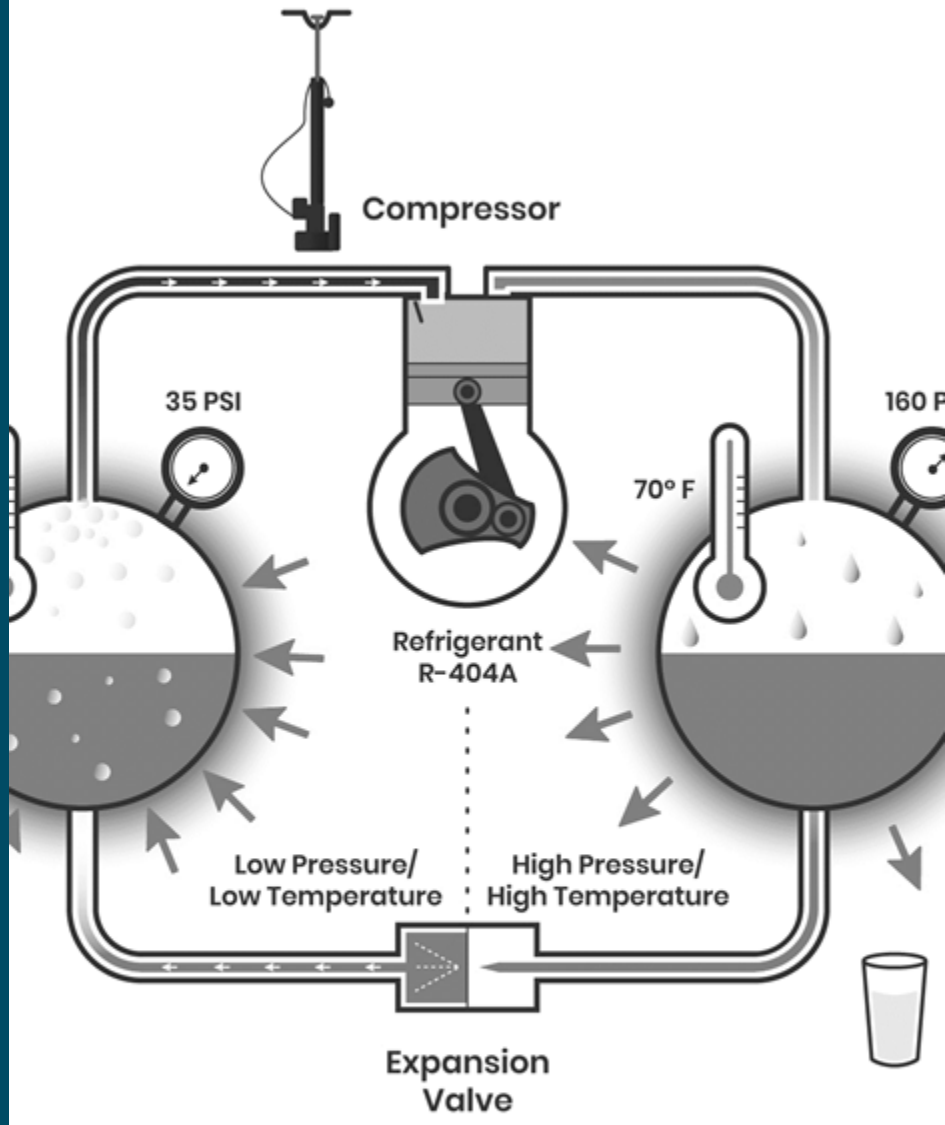
## Energy Efficiency Measures

How do you build resiliency?

## Equipment Maintenance

How do you deliver continued environmental, economic and health benefits?

# Intro to Refrigeration



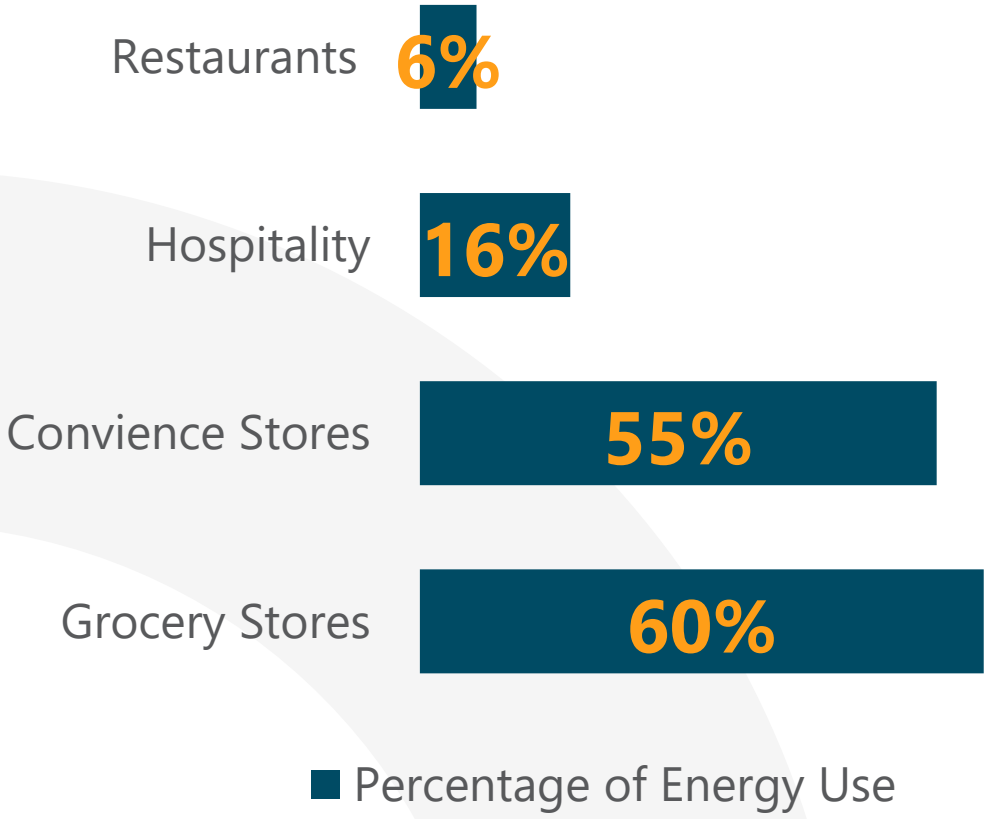
# What are refrigerants?

# Refrigerants are responsible for the miracles of modern life

# Where refrigerants are found: commercial


# Where refrigerants are found: residential


# Refrigeration accounts for 17% of energy consumption worldwide




veic

# Why do we focus on refrigeration?

- Address top climate change issues
  - High-GWP refrigerants
  - Food waste
- Impact
  - Significant energy and non-energy CO2e savings
  - VEIC's true north


Kg/year (Gustavsson et. al., 2011)

# Why should you focus on refrigeration?

- Large energy savings
- Low incremental costs
- High measure volume
- Untapped market
- Climate change
- **Resiliency**

veic

veic

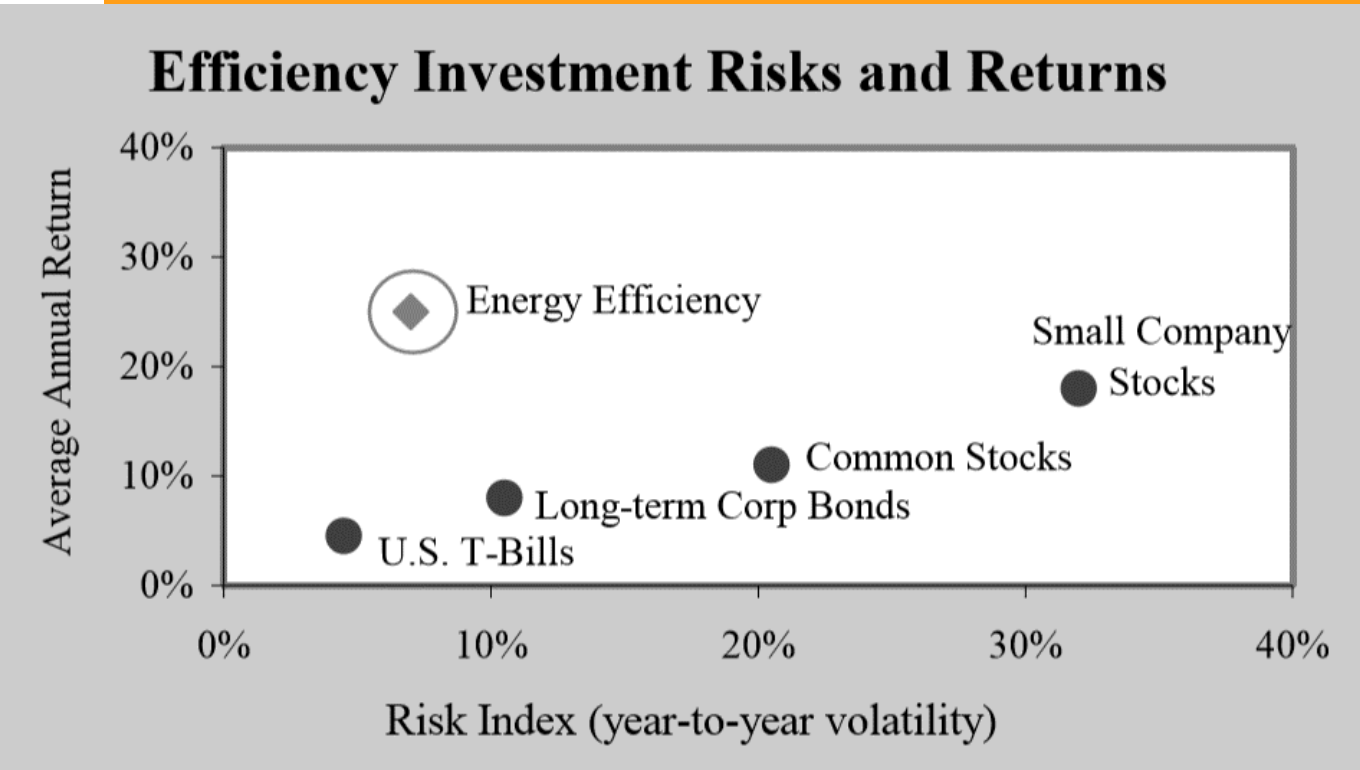
# Why should your customers focus on refrigeration?

# Refrigeration is cheap compared to the product it is storing

veic

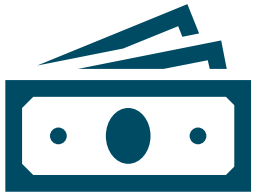
# Good place for businesses to put their money

# (if done appropriately)




Source: ACEEE estimates for energy efficiency; other estimates adapted from the Vanguard Group.

# Customer benefits: new refrigeration equipment



## Reduce Energy Costs

Buying new efficient refrigeration equipment can pay for itself with energy savings.

## Increase Reliability

New equipment can be both more efficient and reliable.

Reduction in food waste, greater margins.

## Short Pay-Back

Typically ~1 year payback when looking at incremental cost and utility incentives.

# Energy Efficiency Measures

# Market & Opportunities

- All customers with commercial refrigeration equipment
- Customer and contractor engagement
- Focus on technologies
- Retrofit or new equipment
- Energy savings, peak reduction, cost savings

# Refrigeration Measures

## Rx / Midstream Measures

- Evaporator Fan Motors / Controls
- HECUs
- HEEvaps
- Anti-sweat Heater (ASH) Controls
- LED Case Lights / Controls
- Night Covers
- Zero Energy Doors
- Refrigeration Add Doors
- Self-Contained Equipment
- CoolBots
- Refrigerant Leak Detection/Repair

## Custom Measures

- Condenser Fan Motors / Controls
- Floating Head Pressure Controls
- Floating Suction Pressure Controls
- Outdoor Air Economizers
- Insulation or Air Sealing (walk-ins)
- Efficient Compressors
- Compressor Heat Recovery
- Refrigerant Leak Detection/Repair
- Consolidate/Downsize Equipment
- Intelligent Freezer Defrost Controls
- Microchannel/Oversized Condenser

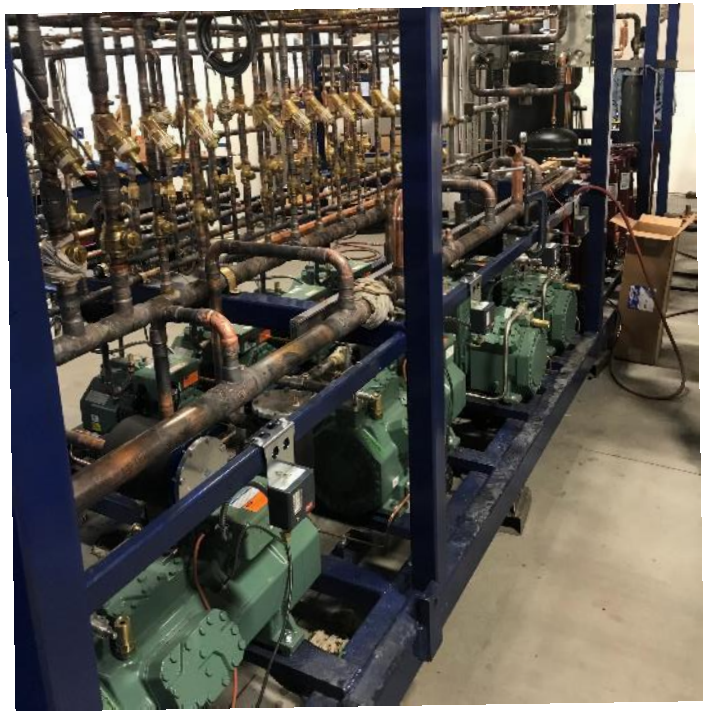
# Markets & Technologies

veic

# Walk-Ins

# Walk-ins: Equipment

## RACKS



## CONDENSING UNITS


## EVAPORATORS

# Walk-ins: Efficiency Measures

- Condensing Units
  - HECUs
    - Scroll compressor
    - EC condenser fan motors
    - Floating head pressure controls
  - Benefits
    - Maintenance savings
    - Equipment reliability
- Evaporators (retrofit)
  - EC evaporator fan motors
  - Benefits
    - Temperature Stability
    - Quick payback

# Walk-ins: Efficiency Measures cont.

- Evaporators (new equipment)
  - HEEVaps
    - EC fan motors & controls
    - Smart defrost
  - Benefits
    - Product quality
    - Reduced maintenance/install costs
    - Quick payback
- Racks
  - Floating head/suction pressure controls
  - Compressor VFDs
  - Benefits
    - Low cost
    - Load matching

veic

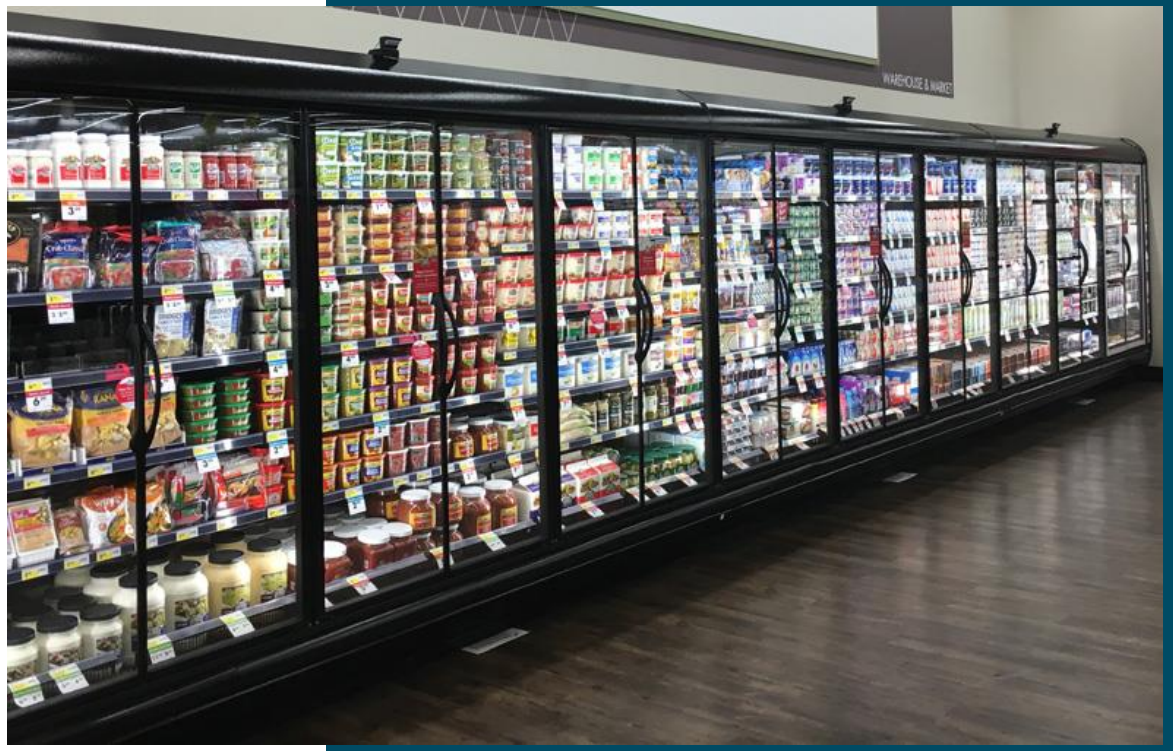
# Remote Reach-in Cases

# Remote Reach-in Cases: Equipment

- Reach-in cases
    - Evaporator fan motors
    - Evaporator coils
    - Lights
    - Doors (closed cases)
    - Door/frame heaters (closed cases)
- New DOE-compliant or Energy Star cases
- Retrofit existing cases

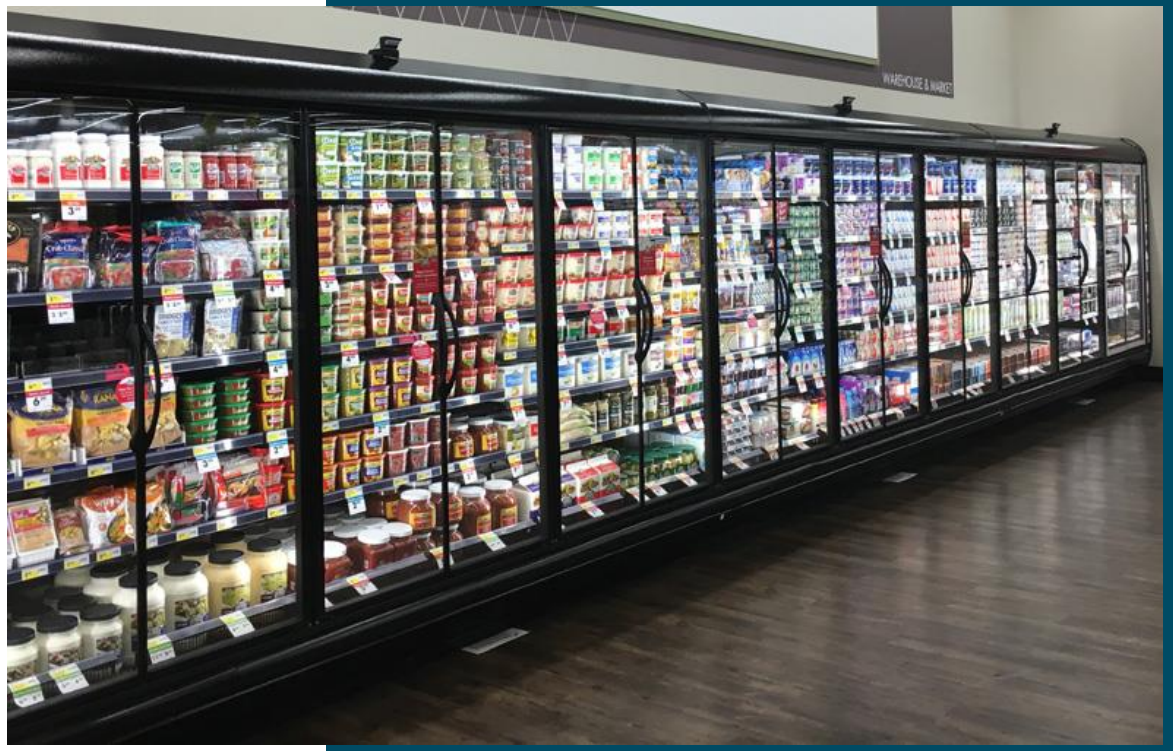
# Remote Reach-in Cases: Efficiency Measures

- Anti-sweat Heater Controls
  - Cycles controls on-demand
  - Reduced heat gain to case
  - Involve refrigeration contractor for savings persistence
- LED Case Lights
  - Improved light and product quality
  - Reduced heat gain to case
  - Opportunity for controls



# Remote Reach-in Cases: Efficiency Measures cont.

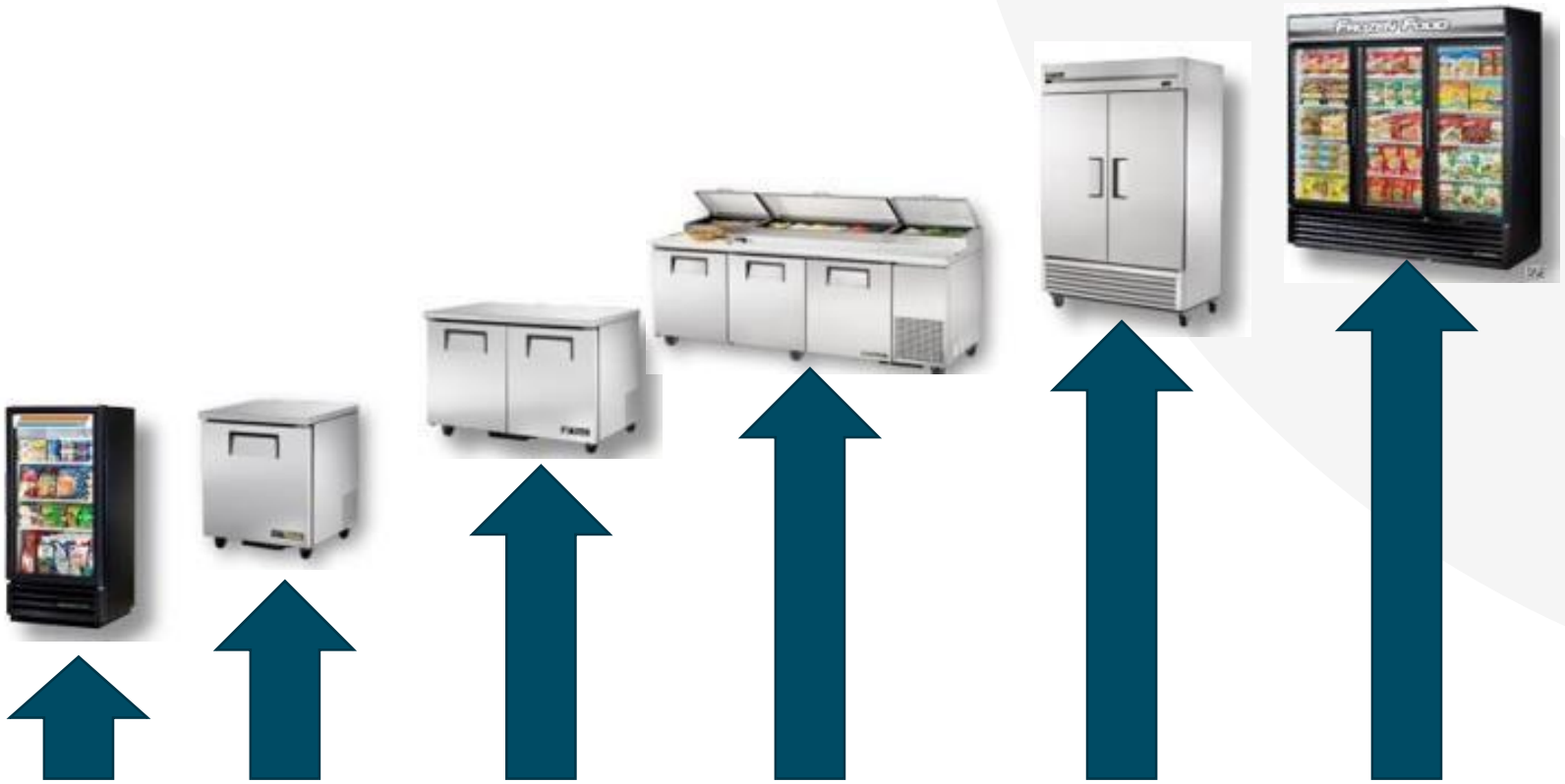
- Night covers okay, **adding doors** much better
  - Increased case efficiency by 70%
  - Increased customer comfort
  - Better light and product quality
  - **Resiliency**
  - More stable case temperatures
  - Involve refrigeration contractor!!!



veic

# Self-contained merchandisers

# Self-Contained Merchandisers



**OVER 85% OF PRODUCT SOLD AVAILABLE IN HYDROCARBON (R290)**

# Self-Contained: Efficiency Measures

- Owned vs rented merchandisers
    - Same measures, slightly different approach
    - Many vendors spec high-efficiency units
- Natural Refrigerant Technologies
- Claiming Energy Savings
    - EnergySTAR
    - DOE vs Energy Code

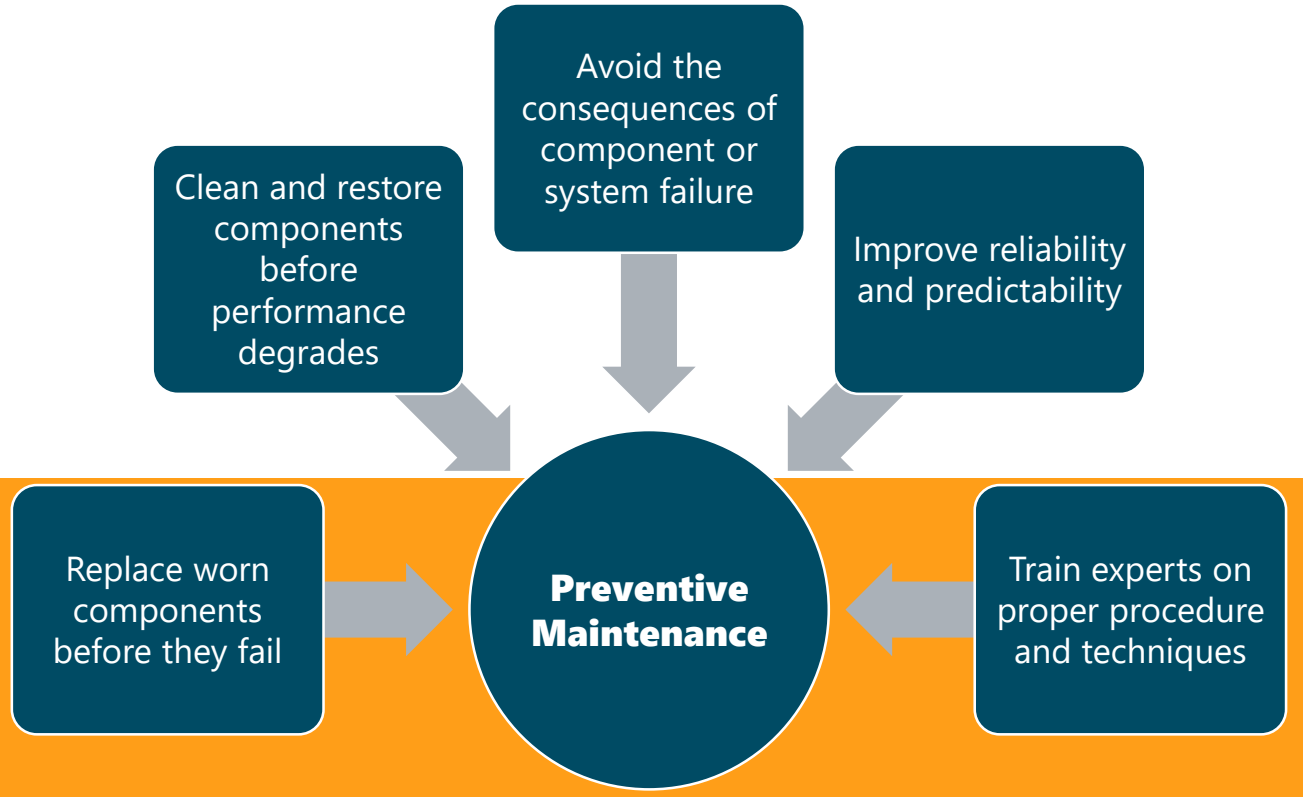
# Self-Contained: Key Benefits

- Energy savings can justify retrofit
    - 30-50%
- Refrigerant Management/Proper Disposal
- New equipment or retrofit
    - Great for expansion/remodels
- Placement Flexibility
- Great opportunity for general stores and convenience stores
- Reduced Waste Heat

veic

# Preventative Maintenance Measures

# Why preventative maintenance?

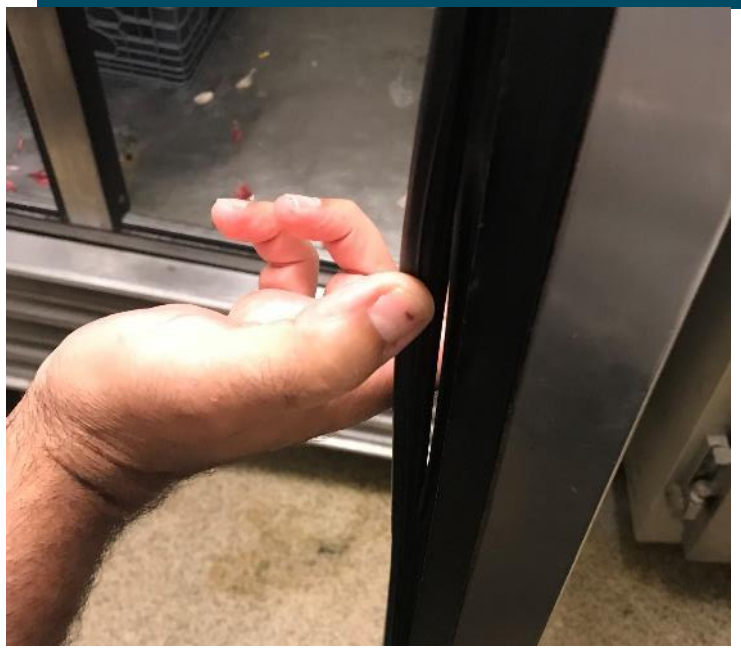



- Energy Savings
  - Although historically difficult to claim
- Gain contractor trust by understanding importance of and advocating for PM
- Customers often don't see value
- Allows for planned equipment upgrades, rather than emergencies

# What is preventative maintenance?

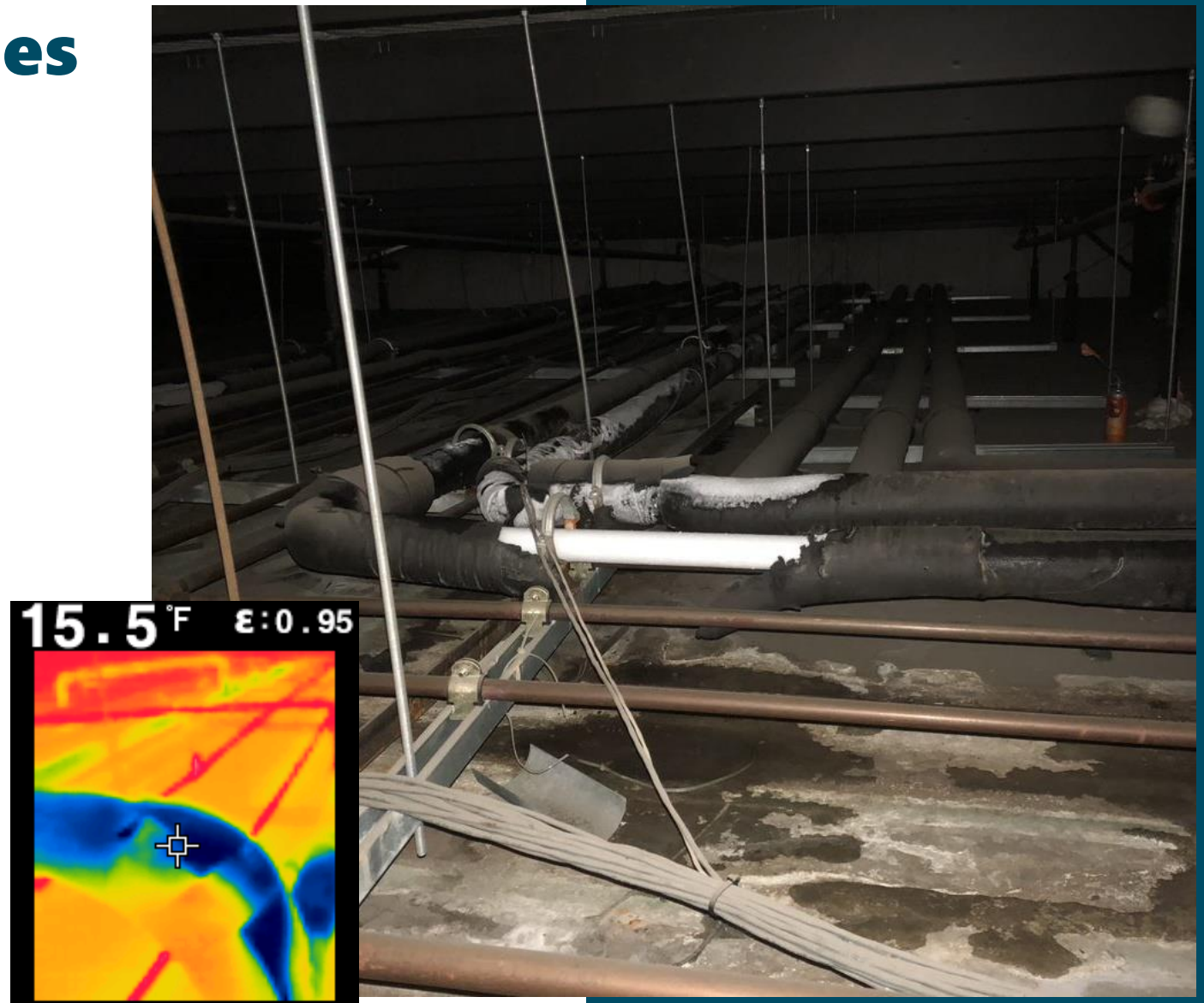
- Door seals
- Filters
- Gaskets
- Air sealing
- Insulate suction lines
- Strip curtains
- Auto door closers
- Refrigerant Leak Repair

...not an exhaustive list!



# Insulate suction lines

- Low side/“inside” piping
- Condensate control
  - Safety issues
  - Product quality issues
  - Significant energy savings

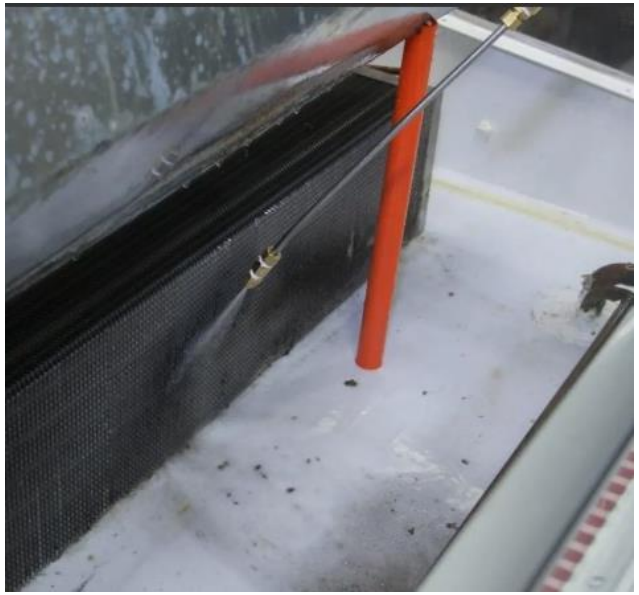


# Coiling Cleaning

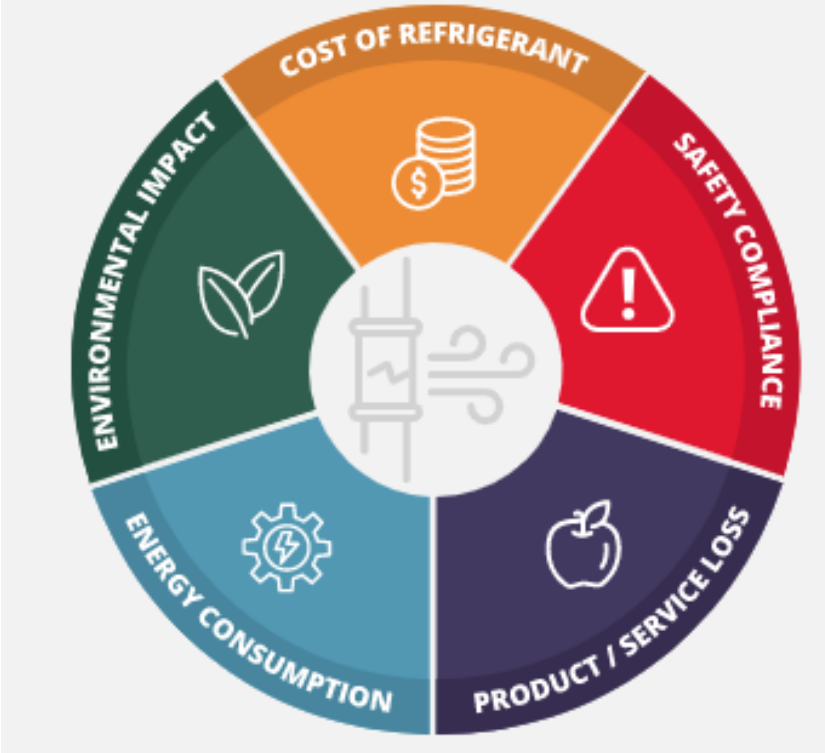
- “Biggest thing you can do for energy efficiency” – Kurt Matzke
- Scale/Dirt on coils reduces heat transfer significantly
    - 1/10” scale = 30% efficiency reduction
- Coils inside store
    - Case evaporators
    - Self-contained
- Coils outside store
    - Condensers/Condensing Units
    - HVAC

# Coiling Cleaning

- Often done by store staff
    - Need to empty cases
- Equipment makes it faster/easier
    - Kaivac Case Cleaner
    - Pressure washer/wet vac
- Benefits
    - Reduced service calls
    - Food safety and quality
    - Case longevity
    - Resiliency

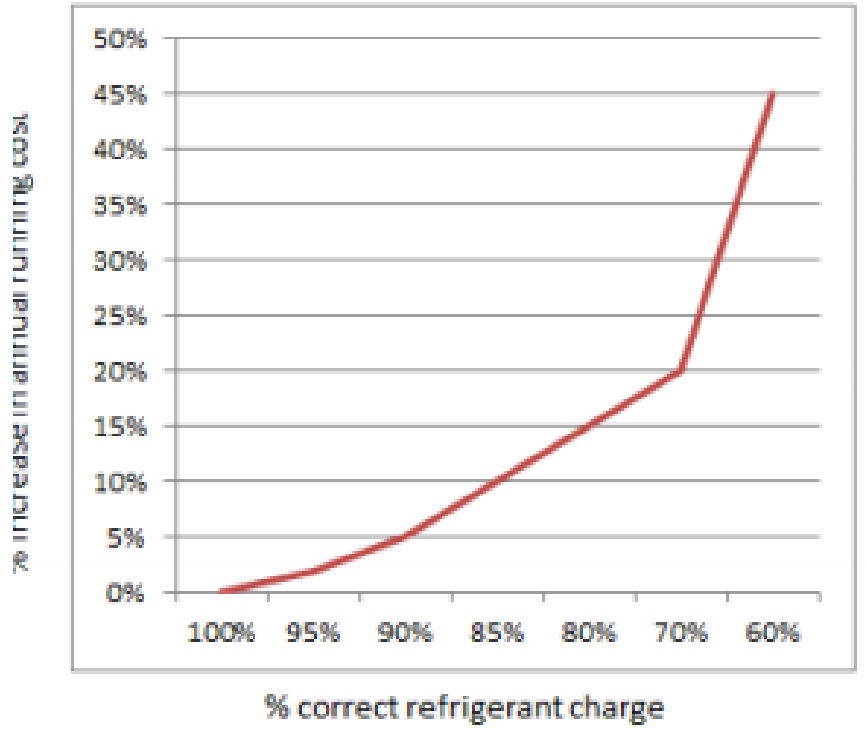



# Refrigerant Leak Detection and Repair




# Energy Efficiency Impact of Leaks

- Varies by system type/configuration, but low refrigerant charge can result in:
  - Increased compressor and condenser duty cycle
  - More annual run hours = more kWh used
  - Some studies estimate 1:1 correlation

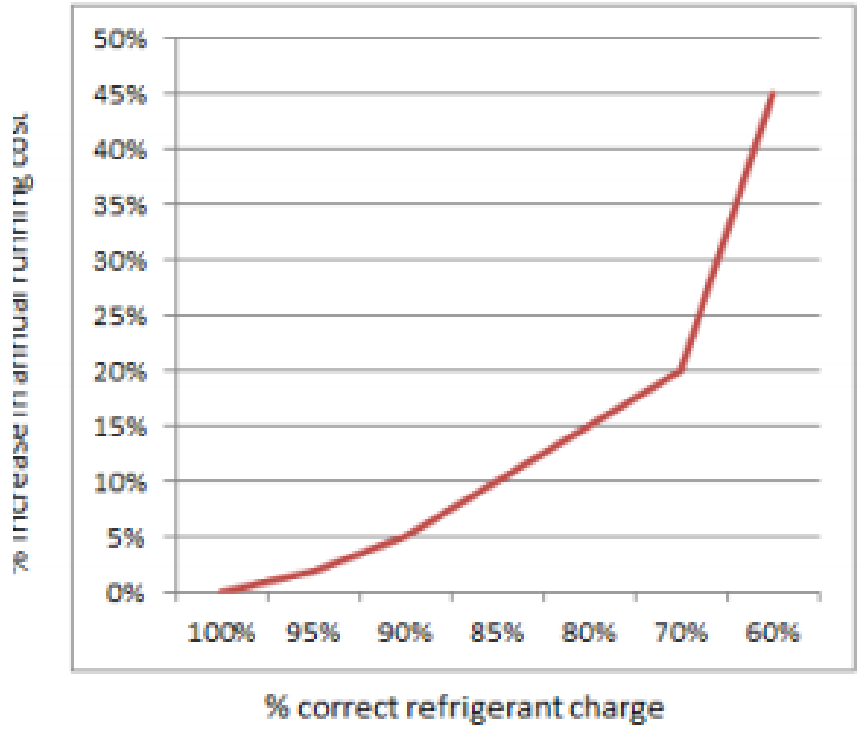



©Institute of Refrigeration Annual Conference 2013

# Energy Efficiency Impact of Leaks

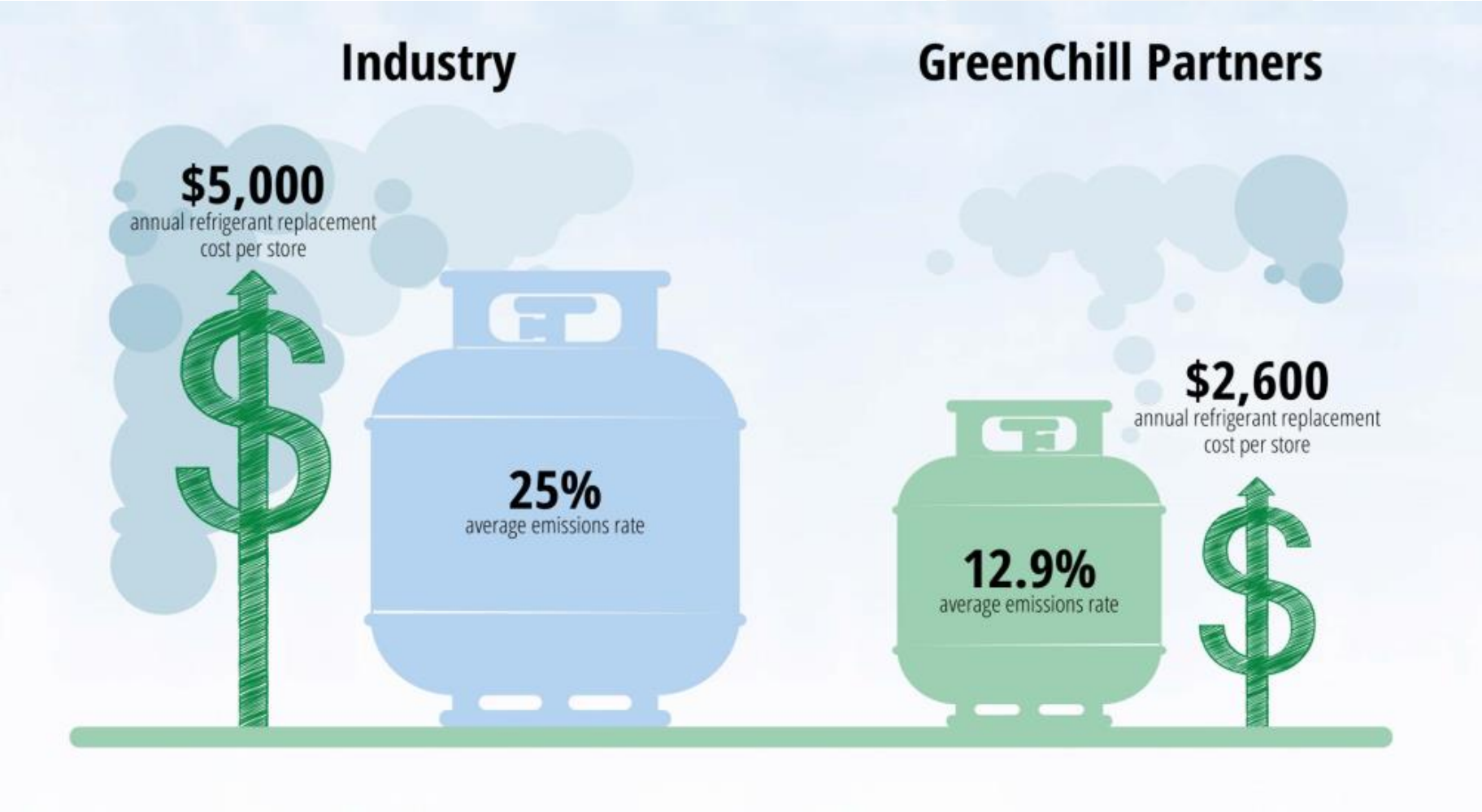
For smaller systems, we have estimated:

- 5 HP Condensing Unit = $250/year in savings
- SMB customer with (4) condensing units ranging from 3-5 HP = $800/year in energy savings
- Relatively small, but small cost ($500-$3,000/project)




©Institute of Refrigeration Annual Conference 2013

# Refrigerant Cost



# Equipment reliability

Low refrigerant charges can lead to:

- Compressor short cycling
- More frequent service calls
- Equipment failures

Which leads to…

- Product quality concerns
- Unexpected expenses
- Decreased system/customer resiliency

# Customer Benefits of Leak Repair

- O&M Cost Reduction
- Energy Savings
- Compliance
- Marketing
  - EPA GreenChill Program
  - Utility Programs
- Equipment reliability
- Product quality
- Environmental Stewardship

# Summary

- Refrigeration systems are serving a critical need and they are still using significantly more energy than is necessary to do so!
- Technical assistance and utility efficiency program funding are more important than ever
- Traditional efficiency projects are still possible
    - Start with low-risk measures
    - Work up to more complex systems
- Preventative maintenance is essential to human, environmental, and economic health
- Refrigeration contractors are strongest allies


veic
Questions

# More Free Trainings....

## May 15, 10 am EDT

**REFRIGERATION.**

Programs that deliver environmental, economic and health benefits.

## May 22, 10 am EDT

**RESIDENTIAL.**

Energy-smart spring cleaning

## May 29, 10 am EDT

**HVAC.**

Unlocking opportunities to maximize energy savings.

# Thank you!


**Zoe Dawson**

zdawson@veic.org

802-540-7699

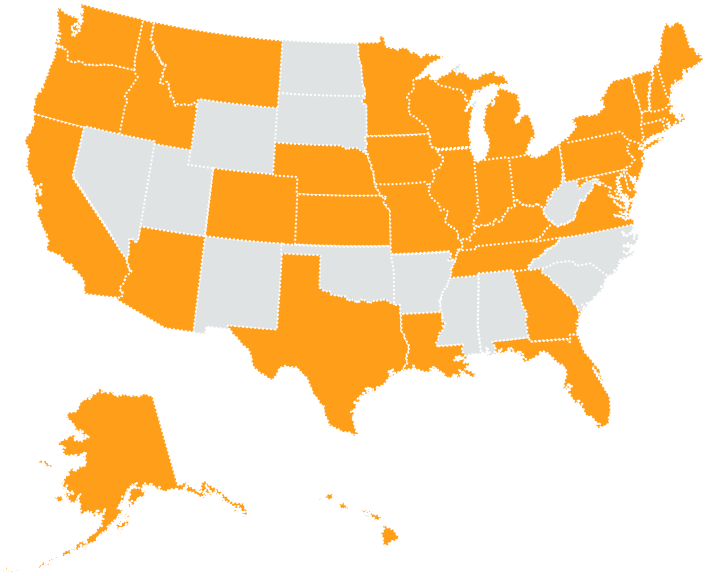
**Vermont**

VEIC Training Series

# Residential: Energy-Smart Spring Cleaning

May 22, 2020

# About VEIC



## We're on a mission to generate the energy solutions the world needs.

VEIC works with organizations across the energy landscape to create immediate and lasting change. Since 1986, we've served as an objective partner for our clients as they navigate complex energy challenges. With expertise in energy efficiency, building and transportation electrification, and new approaches for a clean and flexible grid, we bring new solutions to the market that meet goals and make change.

veic

**Together with our clients, we've been delivering customized trainings to the market to build expertise and drive value with end-use customers.**

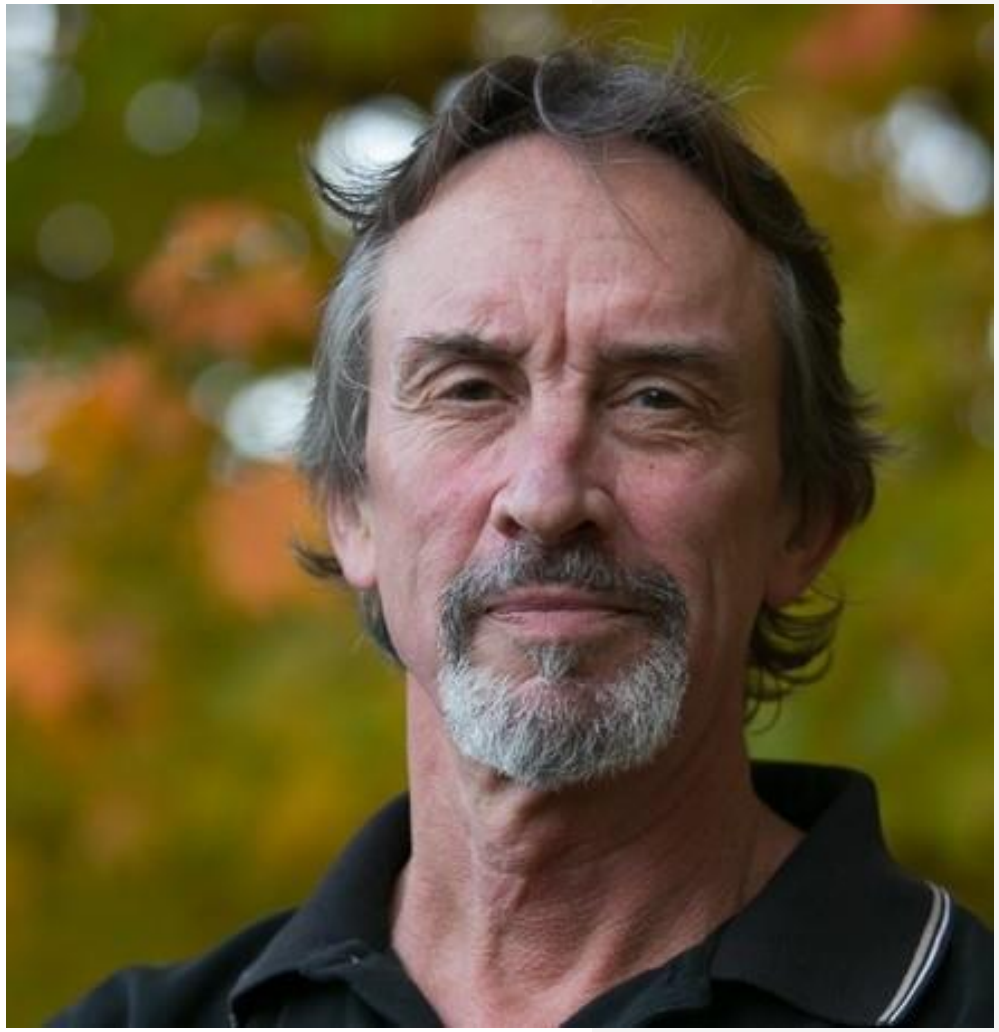
# Our residential expert

## David Keefe

### Residential Energy Consultant

Dave Keefe is an old hippie and fifth-generation Vermonter who has worked for over 34 years as a contractor, consultant and trainer to make homes more comfortable, healthier and less expensive to operate. He has delivered over 1000 sessions and is known as a personable and friendly teacher who loves to answer questions. In 2017, Dave was awarded the Linda Wigington Leadership award, which "showcases individual leadership as demonstrated by outstanding initiative, impact of work, and inspiration to others".

.



# Agenda

Stuck At Home?

Want A More Efficient House?

Need Some Ideas?

How about 20 Ideas?

veic

veic

# 20 home energy things to do (or to consider) while we are staying home

# Idea #1

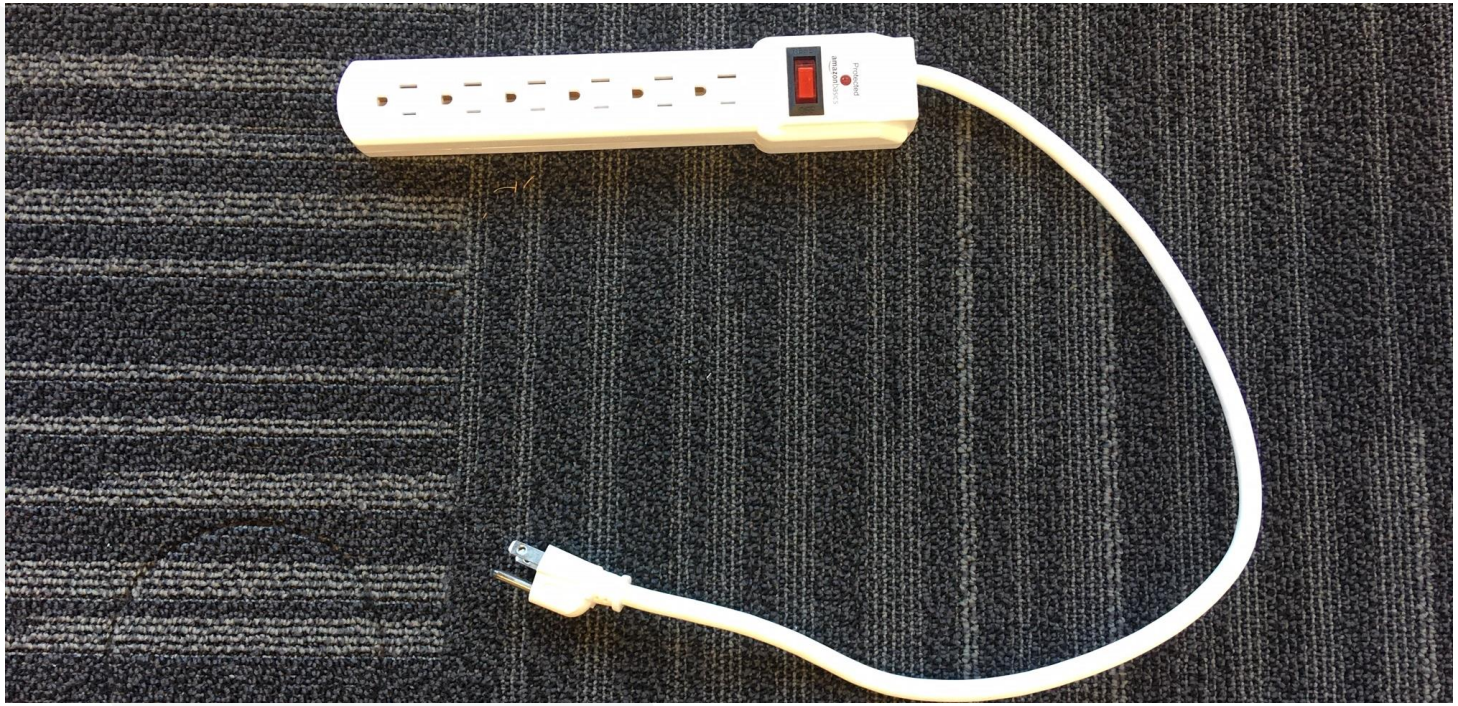
Inspect / clean your chimney(s)

# Idea #2

Dry out your basement / crawl space

# Idea #3

Power-strip your electronics

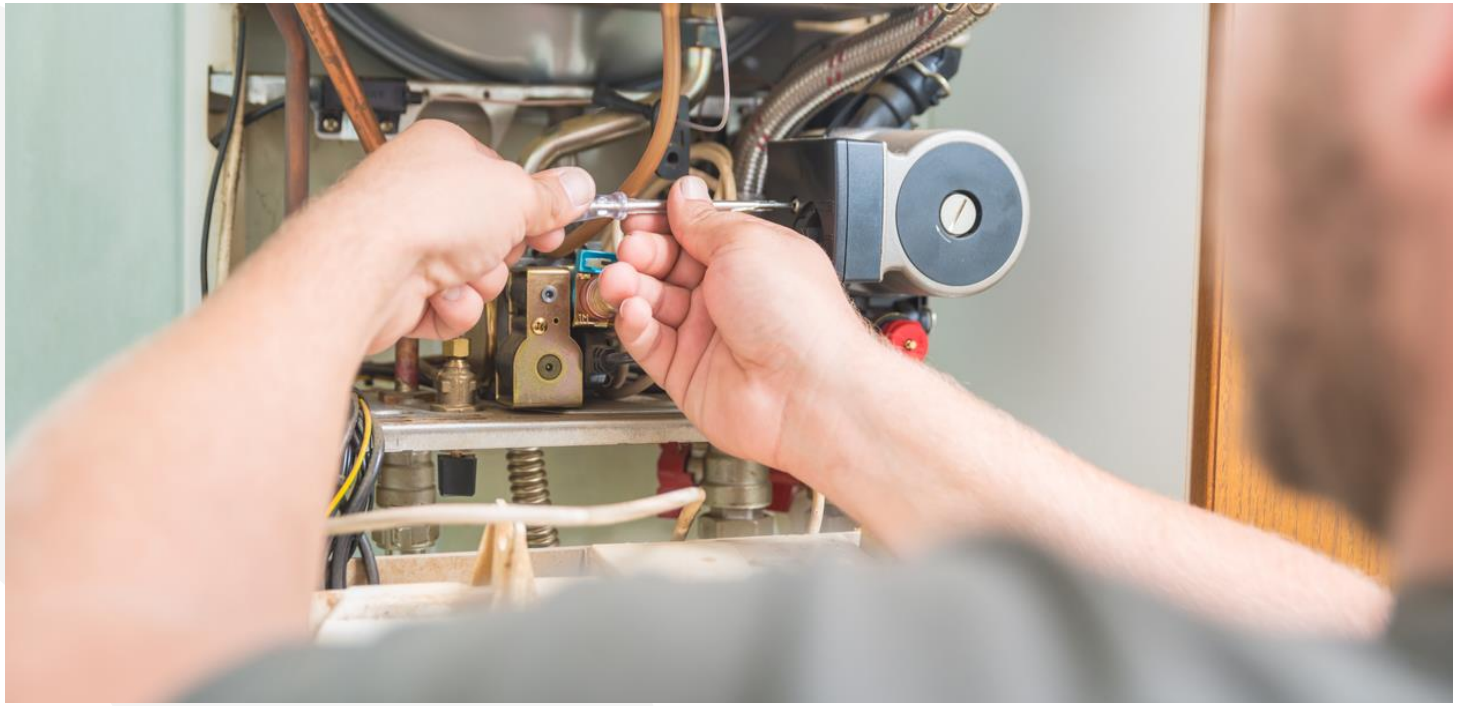


# Idea #4

Clear out the attic

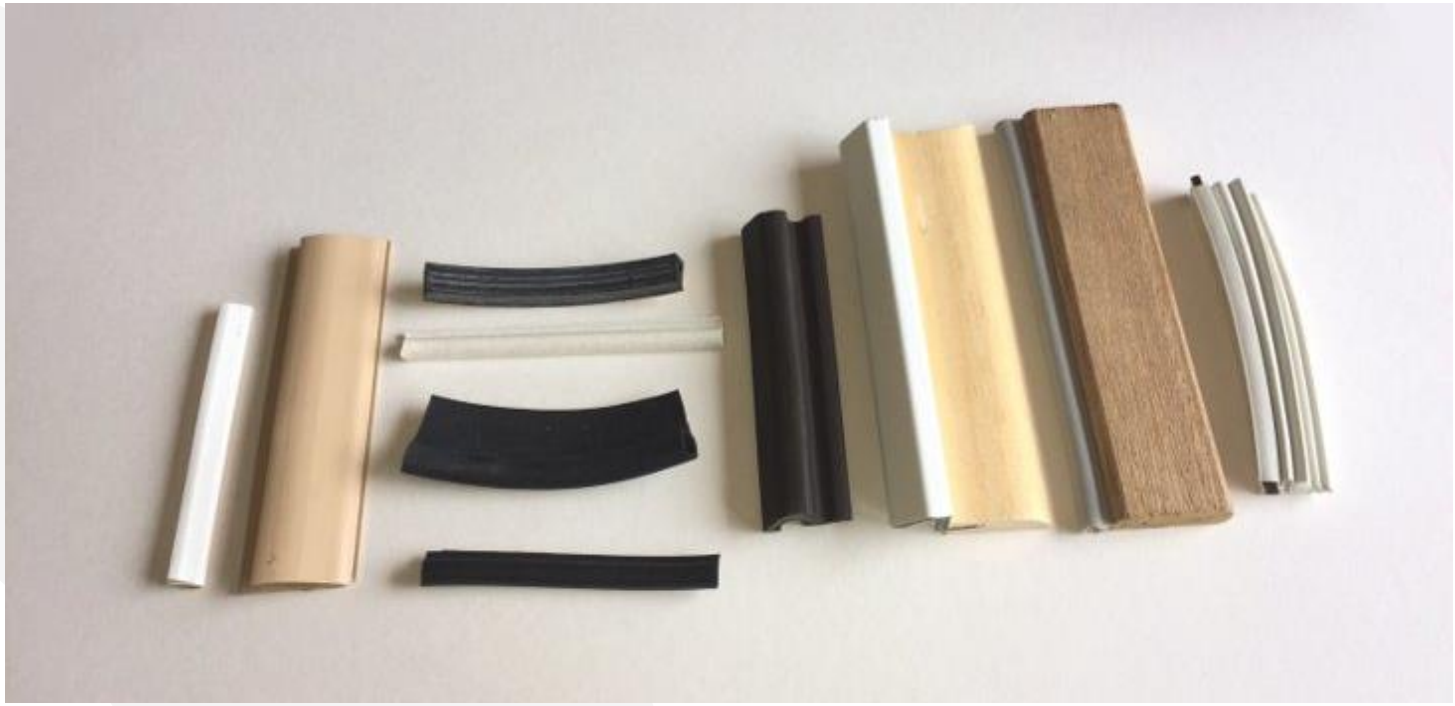
# Idea #5

Have your heating equipment serviced



# Idea #6

Weatherstrip something



# Idea #7

Clean out the dryer vent

# Idea #8

Tune or upgrade your lawn mower

# Idea #9

Get a low-flow shower head

# Idea #10

Check your tire pressures

# Idea #11

Clear out the basement

# Idea #12

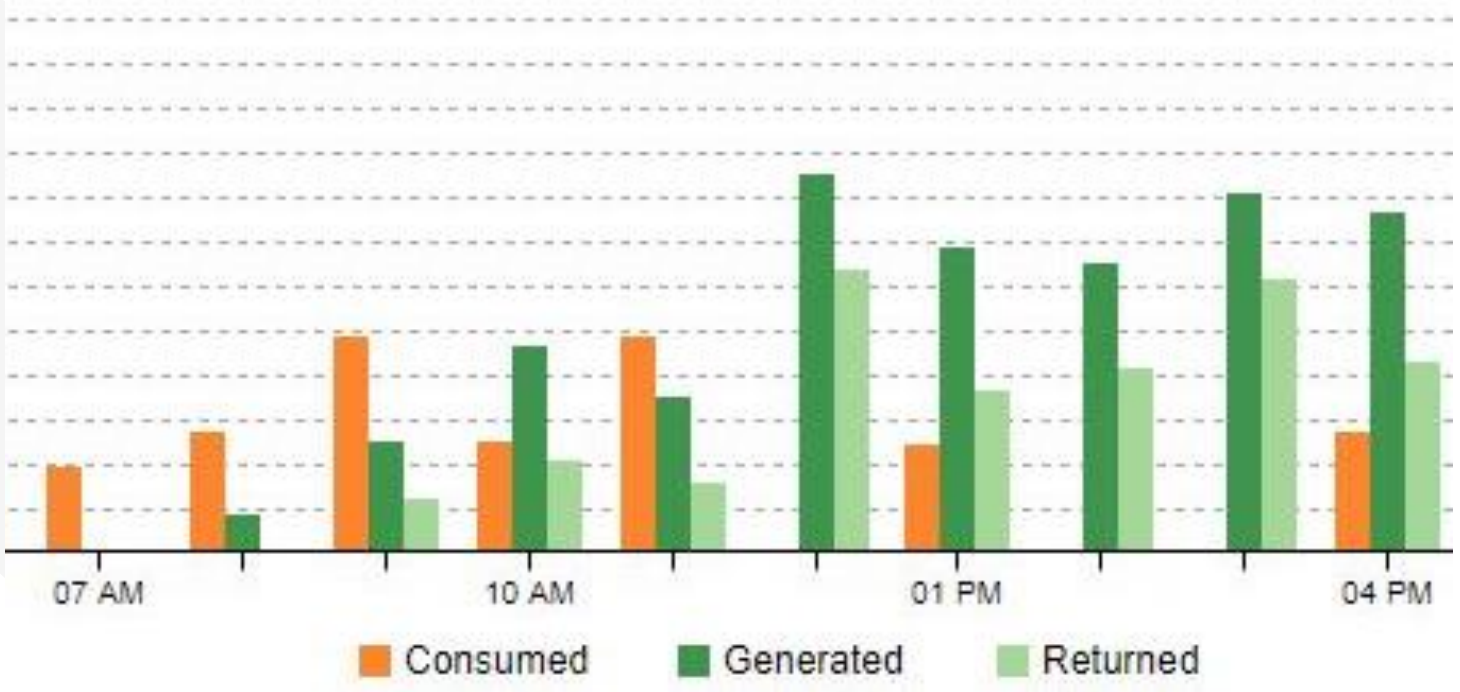
Turn over the compost pile

# Idea #13

Insulate your band joist

# Idea #14

Check out your utility's website



# Idea #15

Seal up some air leaks

# Idea #16

Consider a cold-climate heat pump

# Idea #17

Evaluate your fossil fuel use

# Idea #18

Investigate electric transportation

# Idea #19

Check for available incentives

# Idea #20

Get your Home Performance project started


veic
Questions

# More Free Trainings....

## May 15, 10 am EDT

**REFRIGERATION.**

Programs that deliver environmental, economic and health benefits.

## May 22, 10 am EDT

**RESIDENTIAL.**

Energy-smart spring cleaning

## May 29, 10 am EDT

**HVAC.**

Unlocking opportunities to maximize energy savings.

# Thank you!

**Zoe Dawson**

zdawson@veic.org

802-540-7699

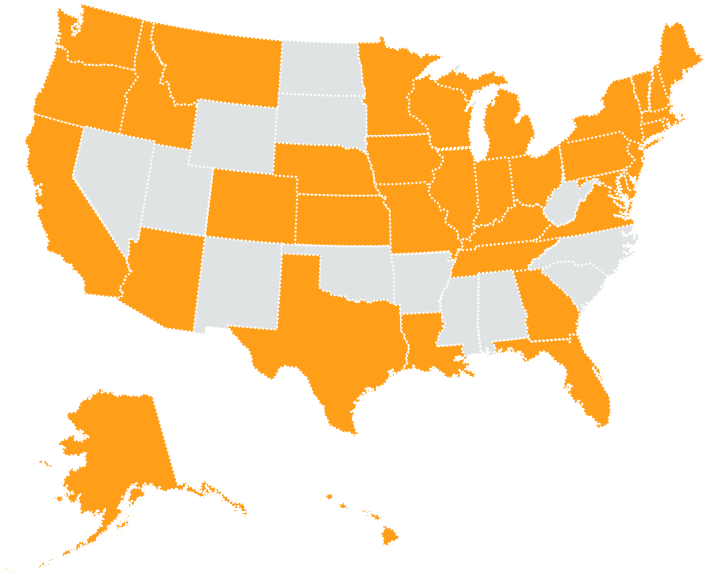
**Vermont**

VEIC Training Series

# HVAC: Unlocking opportunities to maximize energy savings

May 29, 2020

# About VEIC



## We're on a mission to generate the energy solutions the world needs.

VEIC works with organizations across the energy landscape to create immediate and lasting change. Since 1986, we've served as an objective partner for our clients as they navigate complex energy challenges. With expertise in energy efficiency, building and transportation electrification, and new approaches for a clean and flexible grid, we bring new solutions to the market that meet goals and make change.

veic

# Together with our clients, we've been delivering customized trainings to the market to build expertise and drive value with end-use customers.

# Our HVAC expert

## Rachael Mascolino

### Senior Energy Consultant

Rachael is a subject matter expert. She specializes in HVAC, energy management systems, and controls and has extensive experience working within the healthcare and industrial sector.

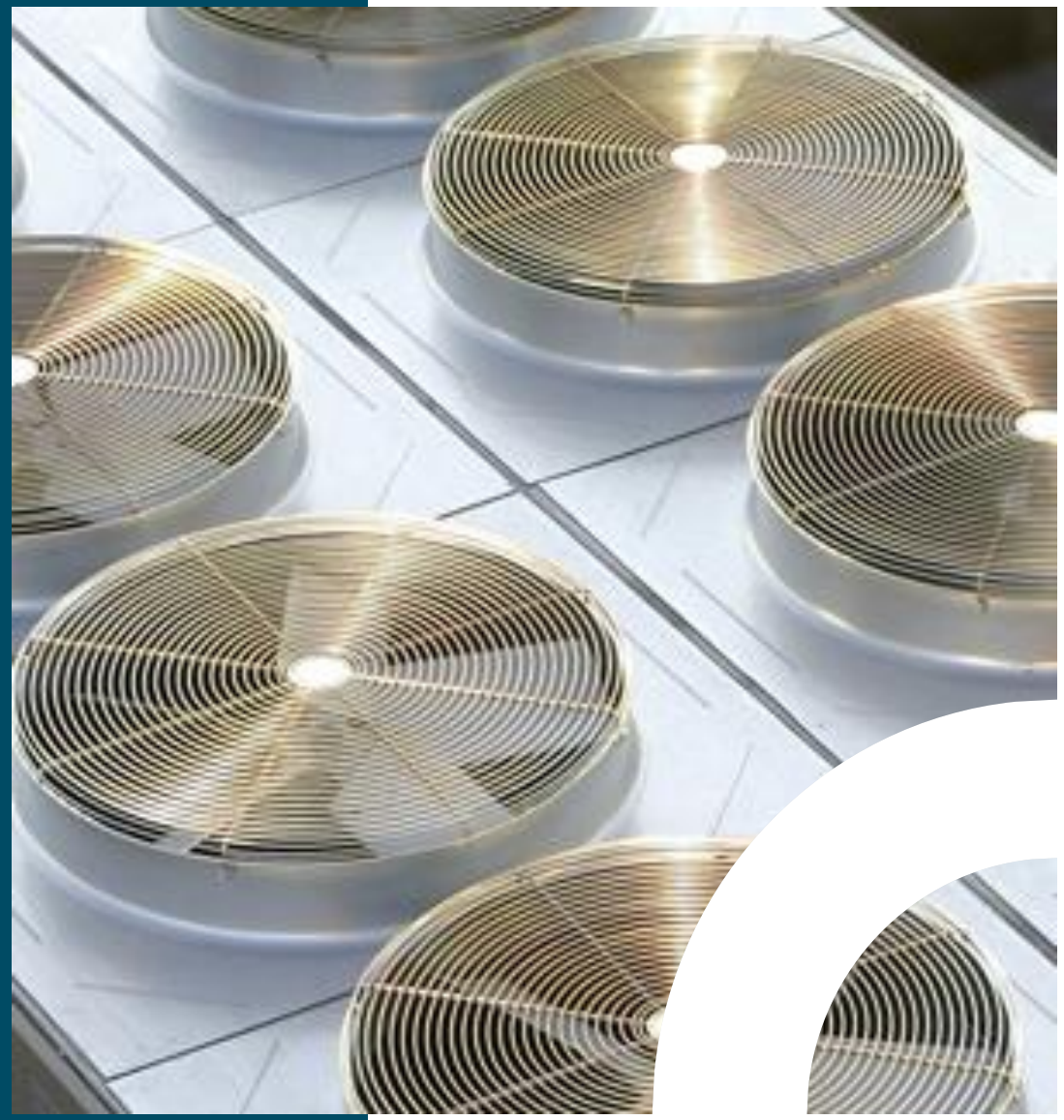
Her specialization has evolved through her evaluations for engineering best practices of design and energy-saving opportunities across multiple measures.

veic

# Agenda

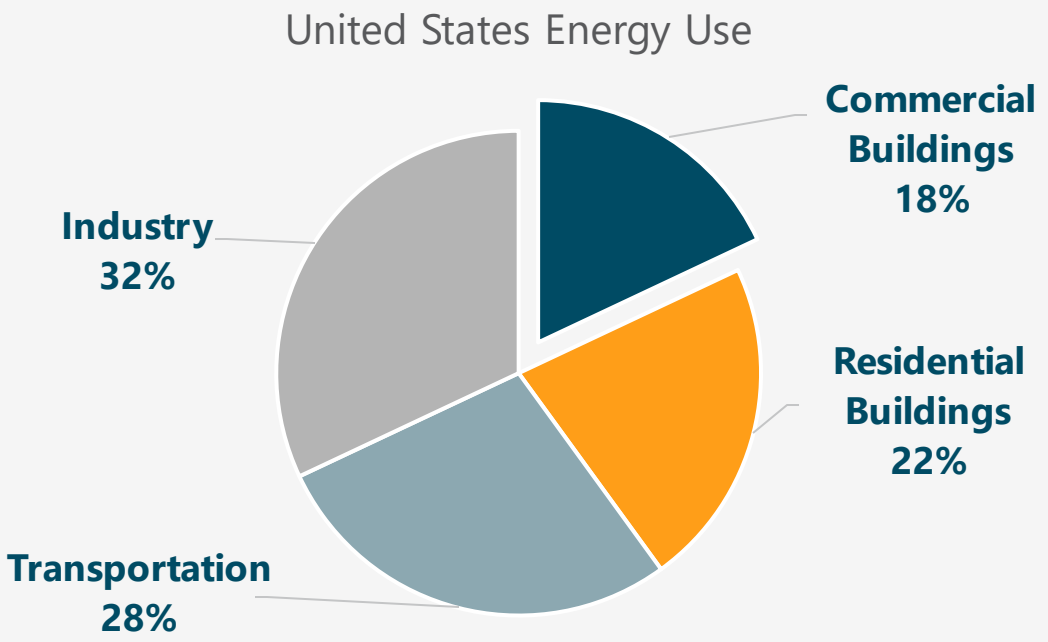
Characterizing buildings for energy savings opportunities

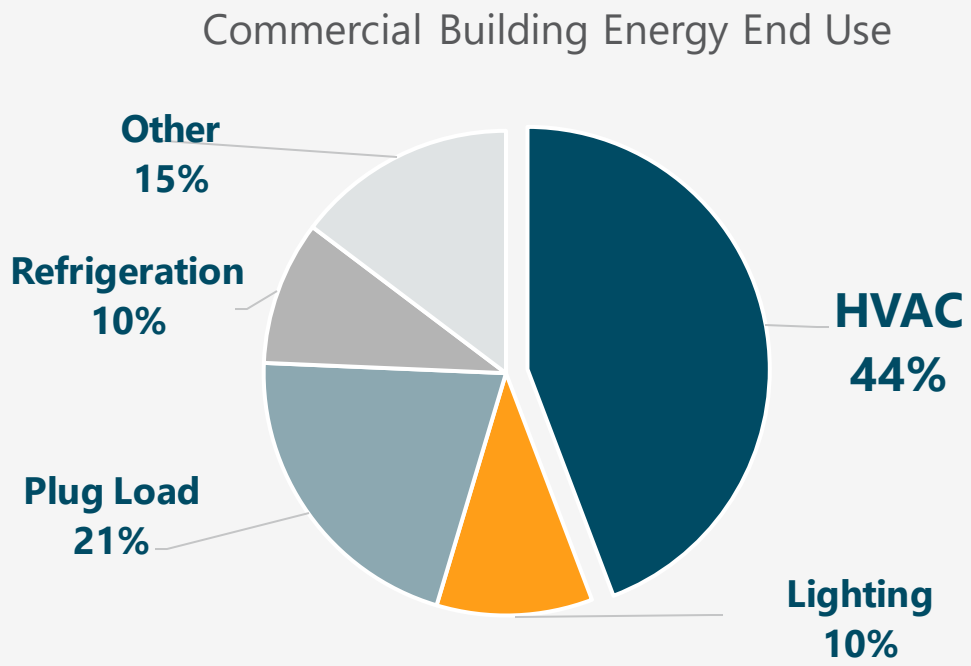
Top thermal and electrical measures



veic

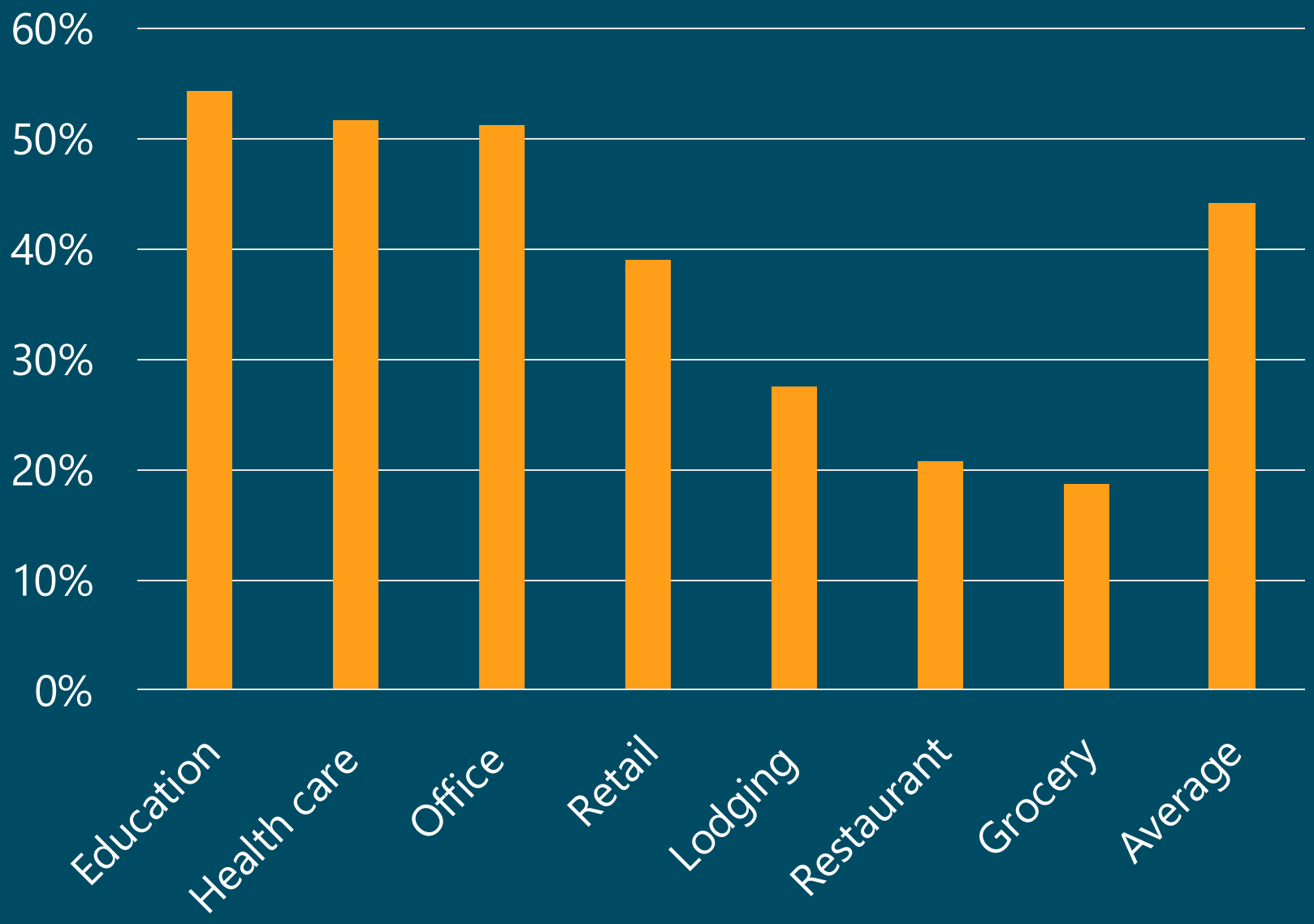
# United States Energy Use




Source: US Energy Information Administration, 2012 Commercial Building Energy Consumption Survey

# HVAC Energy end use by market

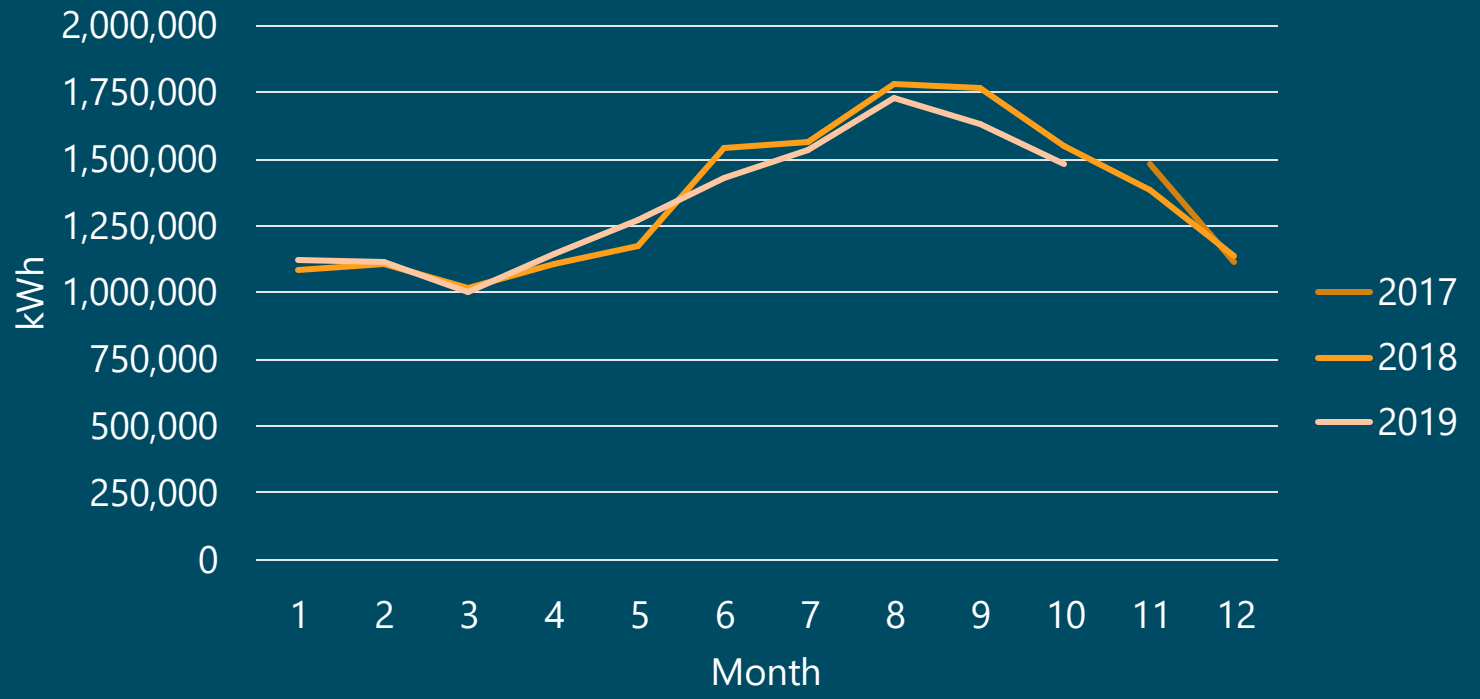


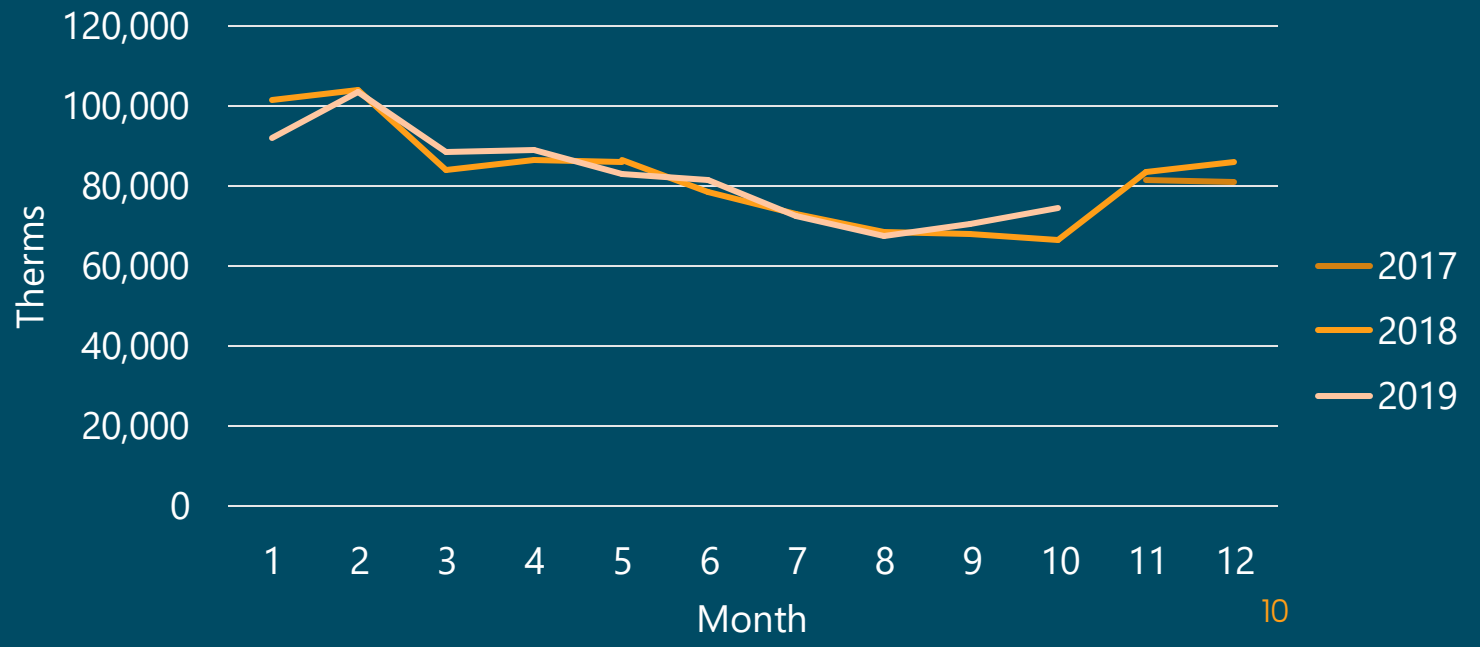
# Characterize your customer

- Before you start talking about efficiency, identify the foundational system to which the efficiency will be applied
- Primary operation and building use
- 2 years of historical usage; electrical and thermal
- Project and efficiency utility engagement history

# A little goes a long way.

With a little information, you can facilitate a succinct and personalized conversation about a customers energy use and opportunities.



# Characterize your customer

- Lead with relevance
- Make the invisible visible
- Provide technical value as soon as possible in the first engagement
- Don’t be the author of another dust collecting report
- Money is cheaper than time

# Thermal measures

## Steam

- Burners
- Traps
- Condensate return
- Pipe, fitting, tank insulation

## Water

- Burners
- Boiler staging/ idling
- Supply temperature reset
- Pipe, fitting, tank insulation
- Air and dirt separation

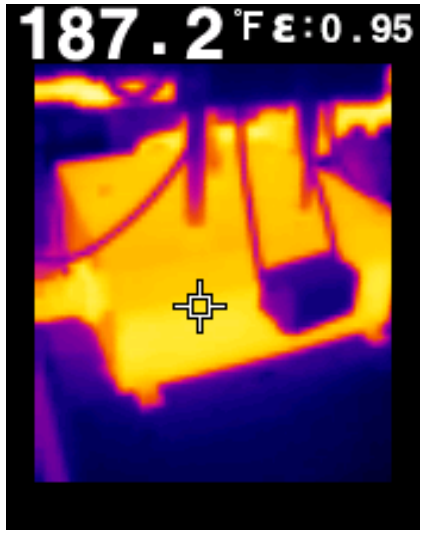
# Thermal measures

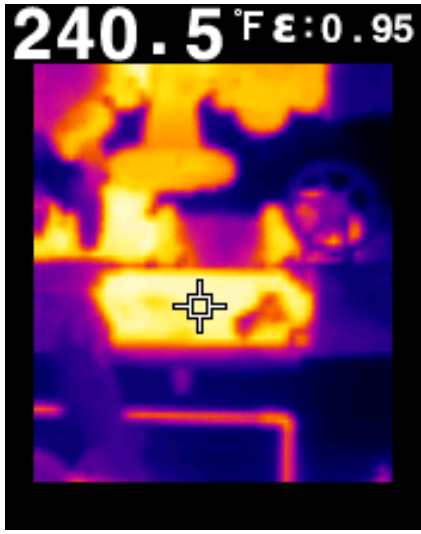
## Steam

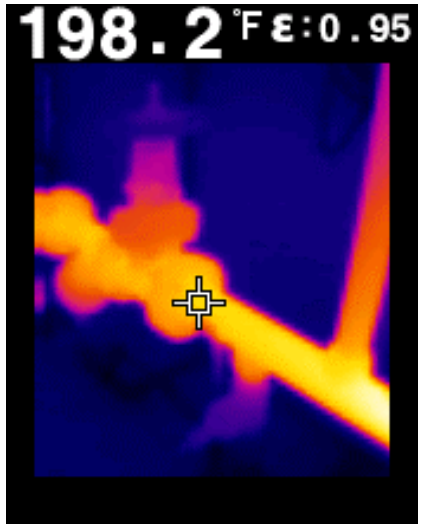
- Burners
- Traps
- Condensate return
- Pipe, fitting, tank insulation

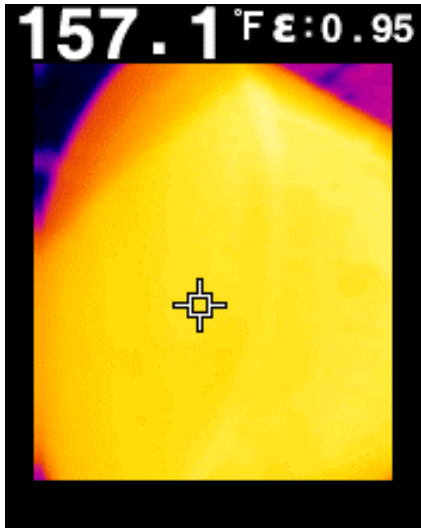
## Water

- Burners
- Boiler staging/ idling
- Supply temperature reset
- Pipe, fitting, tank insulation
- Air and dirt separation



# Thermal measures

## Steam

- Burners
- Traps
- Condensate return
- Pipe, fitting, tank insulation

## Water

- Burners
- Boiler staging/ idling
- Supply temperature reset
- Pipe, fitting, tank insulation
- Air and dirt separation

| Measure | Simple Payback |
|---|---|
| Steam trap audit & repair/replace failed traps | < 6 months |
| Optimize boiler staging | < 6 months |
| Reduce boiler pressure | <1 week |
| Add insulation to steam pipes and valves | <18 months |
| Add outside air temperature reset control to hot water boilers | <2 years |
| Enable differential pressure control of hot water pump VFDs | <2 months |
| Add O2 trim to boiler burner controls | 1 year |

# Demand side efficiency

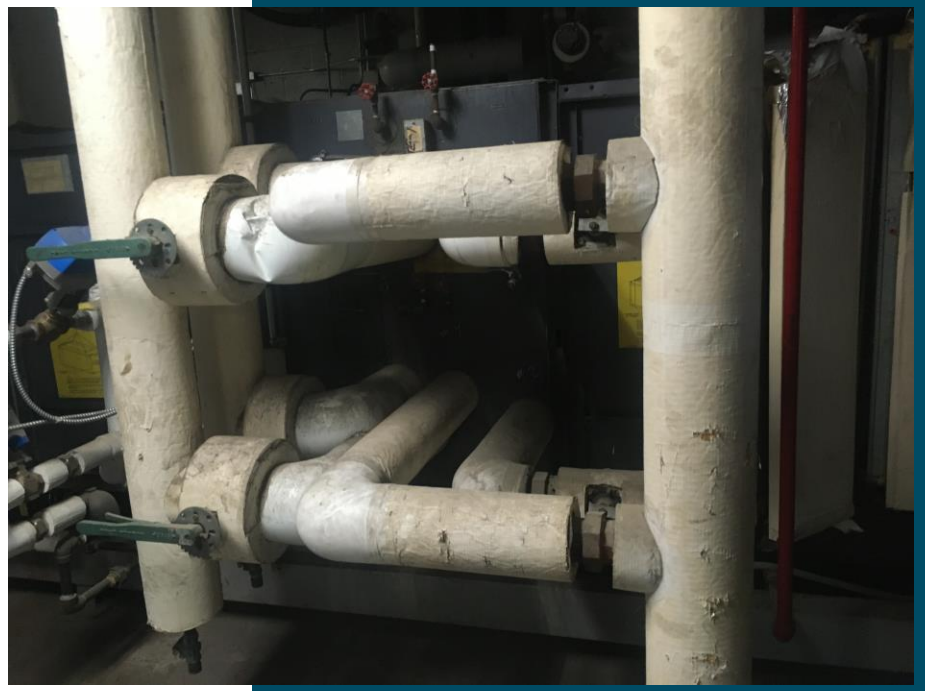
## Thermal and Electrical Savings

- What are you asking your equipment to do?
- You don't need to be a controls savant or programmer.  Follow the communication path.
- Visibility = energy savings.
    - kw/ton of the chiller
    - Air flow
    - Damper and valve positions

# Demand side efficiency

## Thermal and Electrical Savings

- What are you asking your equipment to do?
- You don't need to be a controls savant or programmer. Follow the communication path.
- Visibility = energy savings.
  - kw/ton of the chiller
  - Air flow
  - Damper and valve positions



# Demand side efficiency

## Thermal and Electrical Savings

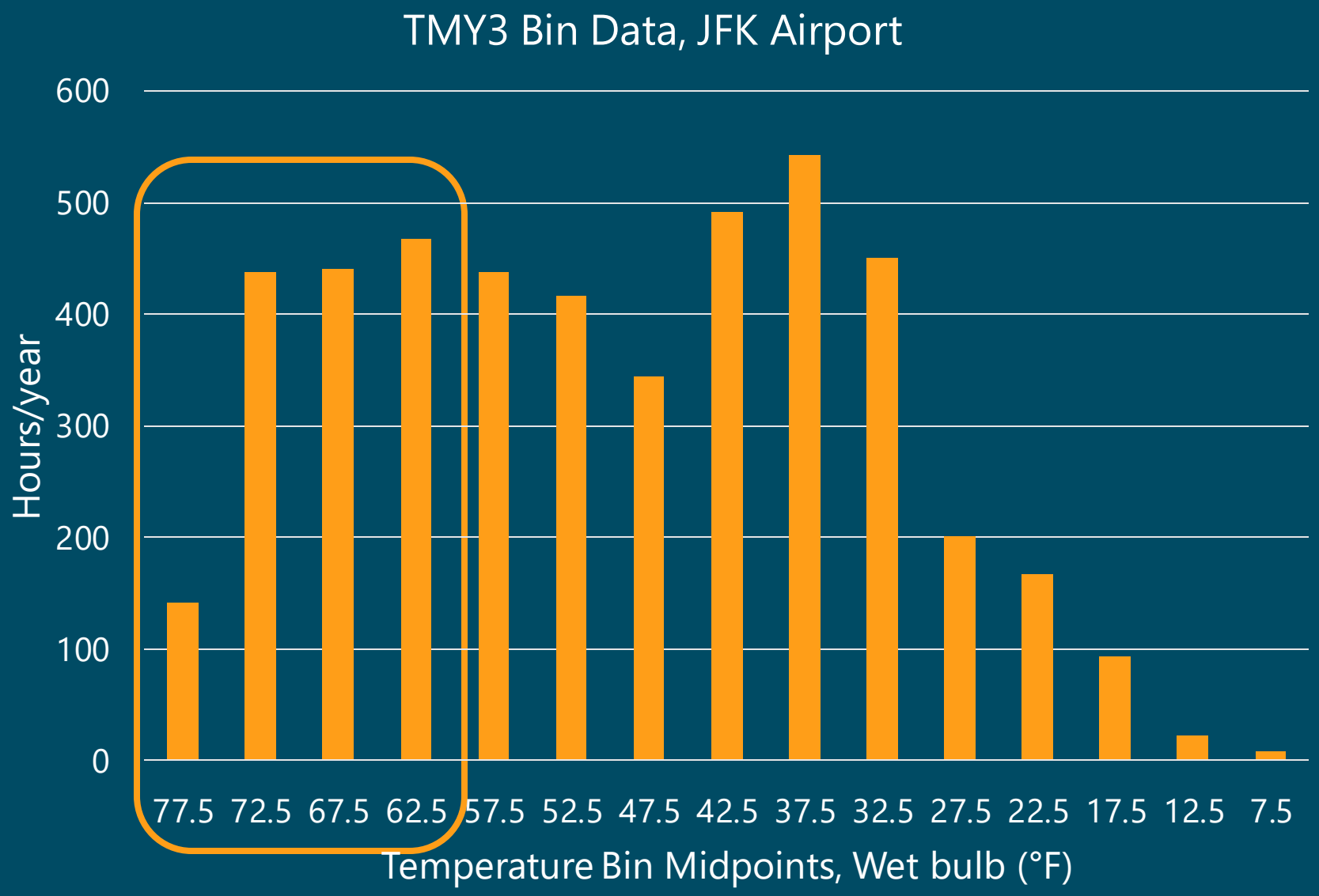
- What are you asking your equipment to do?
- You don't need to be a controls savant or programmer. Follow the communication path.
- Visibility = energy savings.
  - kw/ton of the chiller
  - Air flow
  - Damper and valve positions

| Measure | Simple Payback |
|---|---|
| Space no longer requires 100% OA. Add damper actuator and controller. | < 6 months |
| Calibrate air flow stations | < 3 months |
| Correct schedule to reflect occupancy | < 1 month |
| Complete differential pressure SOO. Take VFDs out of hand | <1 month |
| Add supplemental cooling to critical zone | < 3 years |
| Air balance to correct excessive air changes | < 1 year |
| Optimal start stop logic | < 1 year |

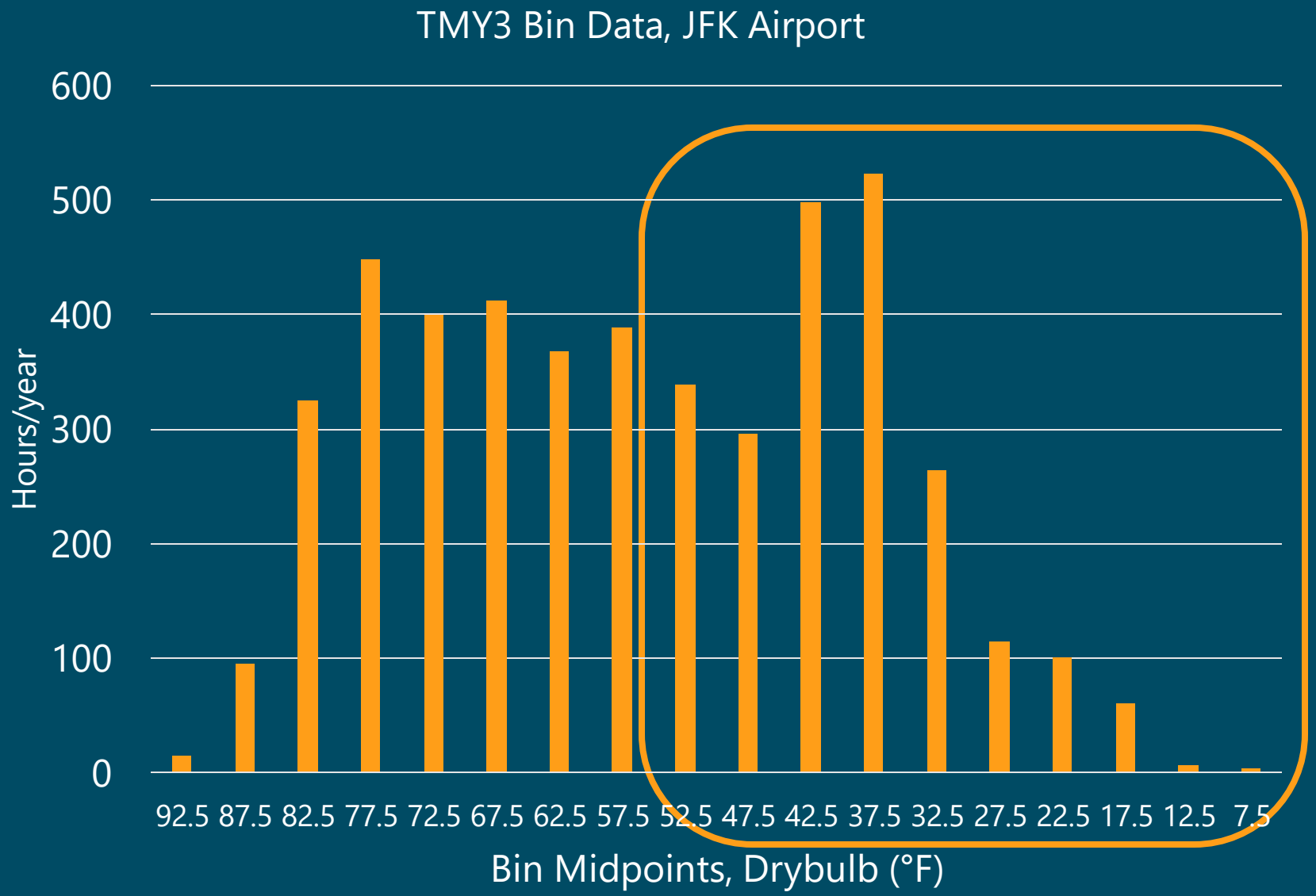
# Ventilation

- Significant and invisible
- Required for human health and productivity
- Where to look for efficiency:
  - Energy recovery
  - Damper actuators and controls
  - Coupled vs decoupled strategy and associated controls

# Hours where OA is in a higher energy state than indoor air.



# Hours where OA has a lower energy state than indoor air.



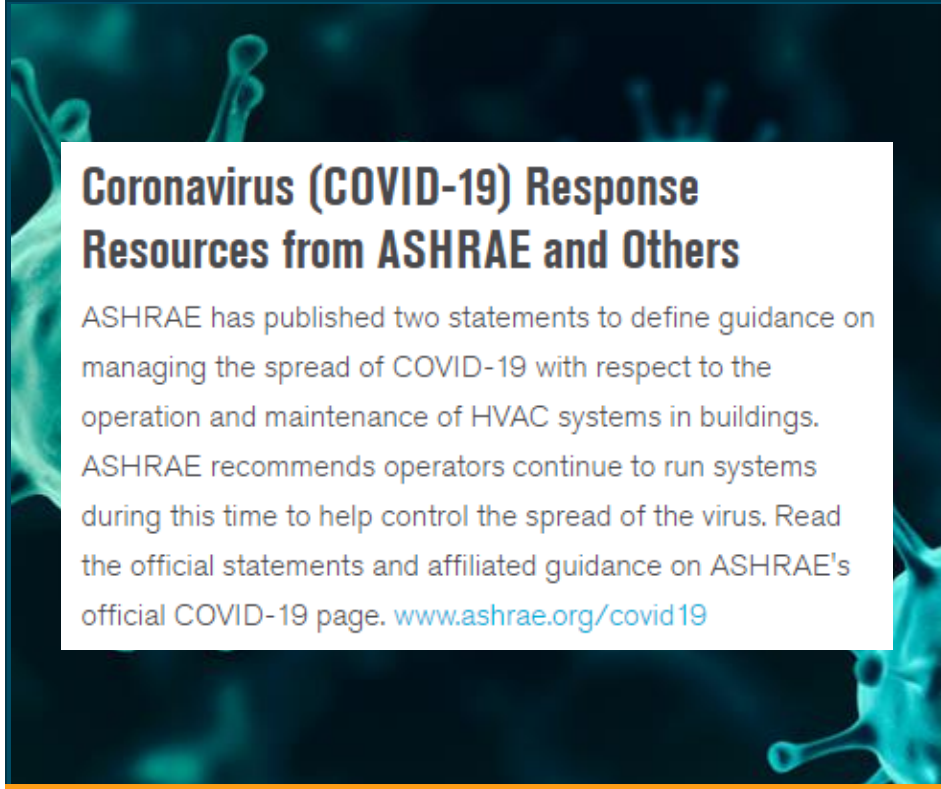
# Ventilation Strategies

## Pre Pandemic

- Meet but do not exceed 62.1
- Occupancy schedules
- What is ACH?
- “there is ventilation air in the hallway, it will get into the conference room.” (magic?)
- MERV 8 filters will keep the pollen out

## Pandemic Mode

- Energy use will undoubtedly increase.
- Over ventilate, as much as possible.
- Pre and post occupancy flush for 2 hours.
- Evaluate use of MERV 13 filters
- RH control 50 +/- 10%
- Control, visibility, proof.





https://www.cdc.gov/coronavirus/2019-ncov/community/guidance-business-response.html

# Keys to unlocking HVAC energy savings

Be a building scientist and a building psychologist.  There is an art to motivating change, and it isn't about the money.

Manage expectations of savings vs. expense. Don't lead with capital improvements.  Help build confidence with savings momentum.

Invest the time and resources to bolster the foundation of your mechanical systems knowledge (or hire VEIC to do it for you).


veic
Questions

# Trainings, services, and more…

**Energy Efficiency**

**Building Electrification**

**Transportation Electrification**

**Clean & Flexible Grid**

# Thank you!

**Zoe Dawson**

zdawson@veic.org

802-540-7699

**Vermont**

# Disclaimer

The opinions and content expressed in this presentation are being provided for general information purposes only.  VEIC makes no warranty, expressed or implied, nor assumes any legal liability or responsibility for the accuracy, correctness, or completeness of any information contained in this presentation.