Vermont Craft Brewer's Conference
November 10, 2023

Sustainable Brewing

Sean Lawson
CEO & Founding Brewer, Lawson's Finest Liquids

Dan Sartwell
Director of Beverage Operations, Black Flannel Brewing and Distilling Co.

Pat Haller & Melissa Stewart
Principal & Senior Engineering Consultants, Efficiency Vermont

Efficiency Vermont

Agenda

Sustainability In The Brewery And Beyond
Lawson's Finest Liquids

Brewing Sustainably
Black Flannel Brewing

Refrigerants in Brewing
Efficiency Vermont

Decarbonization Efficiency Vermont

Lawson's Finest Liquids

Sustainability In the Brewery And Beyond

11/10/2023

- Certified B-Corp in 2023
- Resources
- Facilities
- Lighting
- Solar
- Refrigeration
- Brewing Process
- Materials Handling
- Wastewater

Lawson's Finest Liquids


Certified
B
Corporation

Lawson's Finest Liquids

Sustainability
In the Brewery
And Beyond

11/10/2023

First Up – Resources!

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Sustainability
In the Brewery
And Beyond

11/10/2023

Resources:

- Brewers Association (BA)
- Master Brewers Association of America (MBAA)
- Efficiency Vermont

RESOURCE HUB

Sustainability

Sub-categories: Benchmarking Energy Green Building Solid Waste Wastewater Water Usage

Environmental stewardship is a top priority for both craft brewers and craft beer enthusiasts. Maintaining a healthy balance between stewardship, social enrichment, and economic vitality is important to the future success of craft brewing. Through the benchmarking work and sustainability manuals, the Brewers Association and its sustainability subcommittee encourages conscientious brewing practices that will ensure the long-term success of the craft beer industry.

Facilities

Reflections: If you could do it "right" from the start….

- Starting from "If you could do it all over again"
- Equipment Efficiency
- Key Takeaways

Starting from IF you could do it all over again…

- **If you have the option, Do it right the first time!**
  - Retrofit is never the easiest/cheapest option
  - Run cost analysis on everything
  - Look for alternative funding sources
- **Work closely with local utilities and third-party energy companies.**
  - Experienced people in energy efficiency
  - They want to give you money
- **Look at long-term benefits**
  - Financial
  - Carbon Footprint
  - Electrical and Process Efficiency

Equipment Efficiency

- **Look at each piece of equipment as a part of the entire production.**
  - What is the intended purpose?
  - Can this be used for other applications?
- **Do your research.**
  - New Technologies and Materials
  - Installation techniques
- **Can I meter this separately?**
  - Electrical distribution
- **Can I put an automatic switch on this?**
  - Any piece of equipment that isn't used 24/7
  - Schedule timers, motion sensing lights, no loss drains.

Key Takeaways

- Do it right the first time if you have the option
- Do your research and prepare
- Be OPEN to change
- Question Assumptions
- Do the Low cost/High Impact projects first
- Work with local utilities and third-party companies

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Sustainability In the Brewery:

Facilities

Facilities/Equipment:

- Lighting
- HVAC
- Refrigeration
- Motors
- VFD's
- Pumps

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Facilities:

Lighting

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Solar Installations

Brewery Rooftop – 73kw DC (2018)

Solar Canopy – 215kw DC (2021)

Warehouse 151 – 155kw DC (2023)

Warehouse 167 – 190kw DC (2023)

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Solar Installations

TOTAL INSTALLED GENERATION CAPACITY
633 kW

TOTAL ANNUAL GENERATION
~570,000 kWh

TOTAL ANNUAL VALUE OF ELECTRICITY PRODUCED
$91,000

AVERAGE ROI/BREAK-EVEN
10 YEARS

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Electric Vehicle Charging

Chargepoint:
14 x Level 2 chargers (16-32kW)

Tesla dedicated:
2 x Level 2 chargers (up to 48kW)

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Electric Vehicle Charging

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Facilities:

Refrigeration

CO2 = Newest Technology

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Facilities:

Refrigeration

3,500 SF Cooler

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Facilities:

Refrigeration

3,500 SF Cooler

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Facilities:

Refrigeration

Electricity Savings = ~ $9,000 / year

Brewery Process and Materials Handling

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SOP's & Efficiency

Waste Water vs Volume of beer packaged					
2019	2020	2021			
5.9	**4.0**	**3.4**	ratio waste water to beer		
			42% Reduced		
Gallons of Propane used per barrels packaged					
2019	2020	2021			
3.91	**2.96**	**2.63**	ratio gallons of propane to BBL's of beer		
			33% Reduced		
Kilowatt hours used vs barrels packaged					
2019	2020	2021			
79.4	**57.6**	**51.2**	ratio kWh per barrel brewed		
			36% Reduced		

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Brewery Process:

Waste Heat Recovery

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Materials Handling:

Recovery for RECYCLING

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Materials Handling:

Recovery for RECYCLING

Casella Waste Management

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Materials Handling:

Recovery for REUSE

Paktech Can Holders

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Materials Handling:

Recovery for REUSE

Paktech Can Holders

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Materials Handling:

Recovery for REPURPOSE

Food Waste To Animal Feed

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Materials Handling:

Recovery for REPURPOSE

Brewery Waste/ Spent Grain To Animal Feed

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Materials Handling:

Recovery for REPURPOSE

Brewery Waste/ Spent Grain To Animal Feed

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Materials Handling:

Recovery for REPURPOSE

Brewery Waste/ Spent Grain To Animal Feed

Wastewater

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Wastewater

Moving Bed Biofilm Reactor (MBBR)

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Wastewater

Moving Bed Biofilm Reactor (MBBR)

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Wastewater

6,500 gal/day Capacity

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Wastewater

Moving Bed Biofilm Reactor (MBBR)

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Wastewater:

Best Practices - Side streaming

Waste Beer

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Wastewater:

Best Practices - Side streaming

Waste Beer

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Wastewater:

Best Practices - Side streaming

High Strength Wastewater

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Thank You!

Questions:
sean@lawsonsfinest.com

Brewing Sustainably

Dan Sartwell
Director of Beverage Operations

BLACK FLANNEL BREWING CO.
TRUE CRAFT

The Place Where Exceptional Craft is Celebrated at Every Turn

Climate Change is Real!

Why we Chose to Invest in Greener Technologies and Practices

- Climate change is here to stay, and as an emerging business we must do our part to reduce our emissions
- Long term financial benefits by using more efficient equipment/practices
- Plan for future state and federal mandates for energy efficiency
- Many pieces of equipment make the process itself more efficient and/or easier
- Would have loved to have done more initially if we had the capital up front
- Working with EVT from the ground floor made it easy to make the right decisions

Energy Efficiency & Conservation

Black Flannel Brewing

- High efficiency glycol chiller with hybrid refrigeration technology
- Glycol piping plumbed with Cool-Fit ABS
- Walk-in coolers use high efficiency glycol evaporators
- Hot and cold liquor (water) tanks
- Full burner modulation on Natural Gas Steam Boiler
- VFDs on all process pumps
- Utilization of process equipment for both brewing and distilling entities.
- Dimmable LED lighting throughout site
- Upgraded building insulation and weatherization
- VFDs on HVAC equipment with smart thermostats
- High strength wastewater sent to anaerobic digester
- Full composting program including paper towels , straws, to go containers, cups, etc.
- Spent grain used for animal feed and dog treats
- Reusing 4 Pack holders which are 100% PCR plastics
- 99% of packaged beer put into aluminum cans
- Nitrogen Generator
- Carbon Dioxide Recapture (future project)

The Essex Experience

- Large Solar Array on all roof structures on site
- In 2005, named first "Green Center" in Vermont
- Efficiency Vermont & Vermont Gas pilot projects
- Multi purpose EV & Tesla fast charging stations

Glycol Chiller

Originally quoted for a 30 Ton G & D chiller w/ single compressor

- Oversized
- Short cycling likely due to low demand for cooling
- Large process and chiller pumps
- No redundancy built in
- Inefficient

- **Purchased J & M Fluidics 12.5 Ton glycol chiller equipped with Dodge Engineering hybrid refrigerant pump technology**
  - Properly sized
  - Separate Lead/Lag chillers that work in tandem (redundancy)
  - Small (more efficient) process and chiller pumps
  - Process pump on VFD controlled by pressure transducer
  - Refrigerant pumps from DEI controls that run when its more efficient to do so.
  - KWh and BTU/hr monitoring to track usage based on process

Glycol Piping

Cool-Fit ABS Pre-insulated piping

Pros

- Brewing industry gold standard
- Pre-insulated
- Weatherproof and mold resistant
- Excellent thermal insulation

Cons

- Expensive up front
- Mechanical contractors hate installing it

Walk-in Coolers

Glycol Cooled

- 3 Coolers with individual temperature control
- Crown Tonka Cooler boxes with 4” insulated walls and Ceilings
- Heatcraft high efficiency glycol evaporators
- Utilize glycol as “refrigerant” which both utilizes the efficient chiller and reduces our risk of refrigerant leaks.
- Evaporators are wired to the glycol control valve, which shuts down the fans when not calling for cooling thus reducing our power consumption.

Data Logging

Chiller Operation: June 2023 – October 2023

- Max Load: 9.22 Tons
- Average Load (when Called on: 3.71 Tons
- Average kw (when Running: 5.67kw
- Average % time both chiller compressors are OFF: 31%
- Average % time only 1 compressor is on: 57%
- Average % time both compressors are on simultaneously: 12%

Materials and Resources
Reduce | Reuse | Recycle

Reduce is first for a reason!

Reducing the use of a material or resource is the most impactful way to make a difference.

- Co2
  - Nitrogen generator/blender
  - Spund tanks where possible (Natural carb)
  - Carbonate in line (you already have the parts)
  - Clean brite tanks under pressure
  - Purge slow and low 3–7 PSI
  - Co2 Capture – Earthly Labs
- Water
  - Blast rinsing when heating/cooling/rinsing tanks
  - Water timers with auto shut off
  - Flow meters to track water usage
- Air
  - Regulate your air compressor to as low as you can.
  - Install low flow air knives and/or sensors on packaging line
  - Install no-loss drains on air compressor
- Switch to a super sacks or silo instead of individual grain bags if able.

Materials
Reduce | Reuse | Recycle

Reuse is great too!

- Paktech reuse program is in full effect across the state. There are over 50k free paktech available now!
- Investing in reusable materials also REDUCES your use of single use materials.
  - Reusable keg straps/bands instead of shrink wrap – Split cost with distributor
  - Clean and reuse keg caps
  - Growlers
  - Glass bottles (Program in Oregon Currently)
- Switch to reusable materials for drinkware, plateware, plasticware, wherever possible.
  - Cup Zero is an excellent company that rents these materials for larger events.
- Reuse yeast whenever possible
- Create a small beer from the second runnings of a big beer (reuse the grain)
- Use spent hops from a dry hop for a kettle bittering addition

Materials
Reduce | Reuse | Recycle

The Recycling system in the US is broken...

- When in doubt, throw it out!
  - Many things that you may think are recyclable are not.
- Vermont Mixed Recycling:
  - #1 (PETE) and #2 (HDPE) rigid Plastics - (no stretch film or crinkle plastic)
  - Glass
  - Cardboard and paper (shredded paper must be in a clear plastic bag)
  - Metal – Steel and aluminum (even aluminum foil)!
  - All of the above need to be **CLEAN** and a minimum 2" on 2 dimensions
  - NO Batteries, electronics, scrap metal, plastic bags, or textiles
- Paktech – very low recycle rate when placed in mixed recycling.
  - Deliver by the pallet to NWSWD in Georgia, VT
  - Talk to your local transfer station about receiving these materials separately
- Grain Bags (#5 plastic with or without #4 liner)
  - Reuse as tote bags, garbage bags, or decoration – This only gets you so far
  - Can be recycled at NWSWD in Georgia, VT
  - Switch to Super sacks or Silo when possible (REDUCE)
- Plastic STRETCH Film
  - Stretch wrap, bubble wrap, plastic bags, any stretchable plastic film
  - Can be recycled at NWSWD in Georgia, VT

Wastewater Side Streaming

- Black Flannel is on a municipal system that has surcharges for High Strength liquid waste
  - High Biological Oxygen Demand (BOD), Total Dissolved Solids (TDS) and Chemical Oxygen Demand (COD).
- Equipment Used (Less than $3k investment)
  - Diaphragm pump (1/8" solids)
  - Waste Tote (IBC)
- Waste is pumped directly out of vessel (mashtun, boil kettle, fermenter) and into waste tote.
- Waste is then picked up bi-weekly and brought to an anaerobic digester at Vanguard Renewables to generate Renewable Natural Gas used onsite to create electricity.
- Not all digesters are the same! Some are specifically designed to handle brewery and food waste.
- Communication with local Waste Water Facility is imperative with a new build
- No one size fits all approach, Do your research

Sustainability Certificate

OF ORGANIC MATERIALS RECYCLING

VANGUARD RENEWABLES

Black Flannel Brewing Co.

This certificate is awarded to ***Black Flannel Brewing Co.*** for sustainably recycling ***20*** tons of organic materials via Vanguard Renewables' organic materials recycling program. This certificate was awarded on October 12th during the calendar year 2023.

13	27	36	1,919	7
Tons Of CO_2e emissions mitigated	Barrels of oil offset	MMBtu's of renewable natural gas generated	Equivalent bus miles fueled	Equivalent tons of coal use avoided

What are refrigerants?

Working fluids in refrigeration cycles

Refrigerants carry energy

What else are refrigerants?

Important

Comfort & safety

Decarbonization & sustainability

Chemicals

Synthetic or naturally occurring

Super-potent greenhouse gases

Handled by technicians

Evolving

Regulations & codes

Technology innovation

Synthetic Refrigerants

CFCs

Chlorofluoro-carbons

HCFCs

Hydrochlorofluro-carbons

HFCs

Hydrofluoro-carbons

HFOs

Hydrofluoro-olefins

Natural Refrigerants

Hydrocarbons

Propane,
Butane,
etc.

Carbon Dioxide

Ammonia

GWP

Global Warming Potential

The relative impact of a substance as a greenhouse gas.

CO2 = 1

…So a GWP of 1,000, means that 1 kg of that substance is equivalent to 1 metric ton of CO2.

ODP

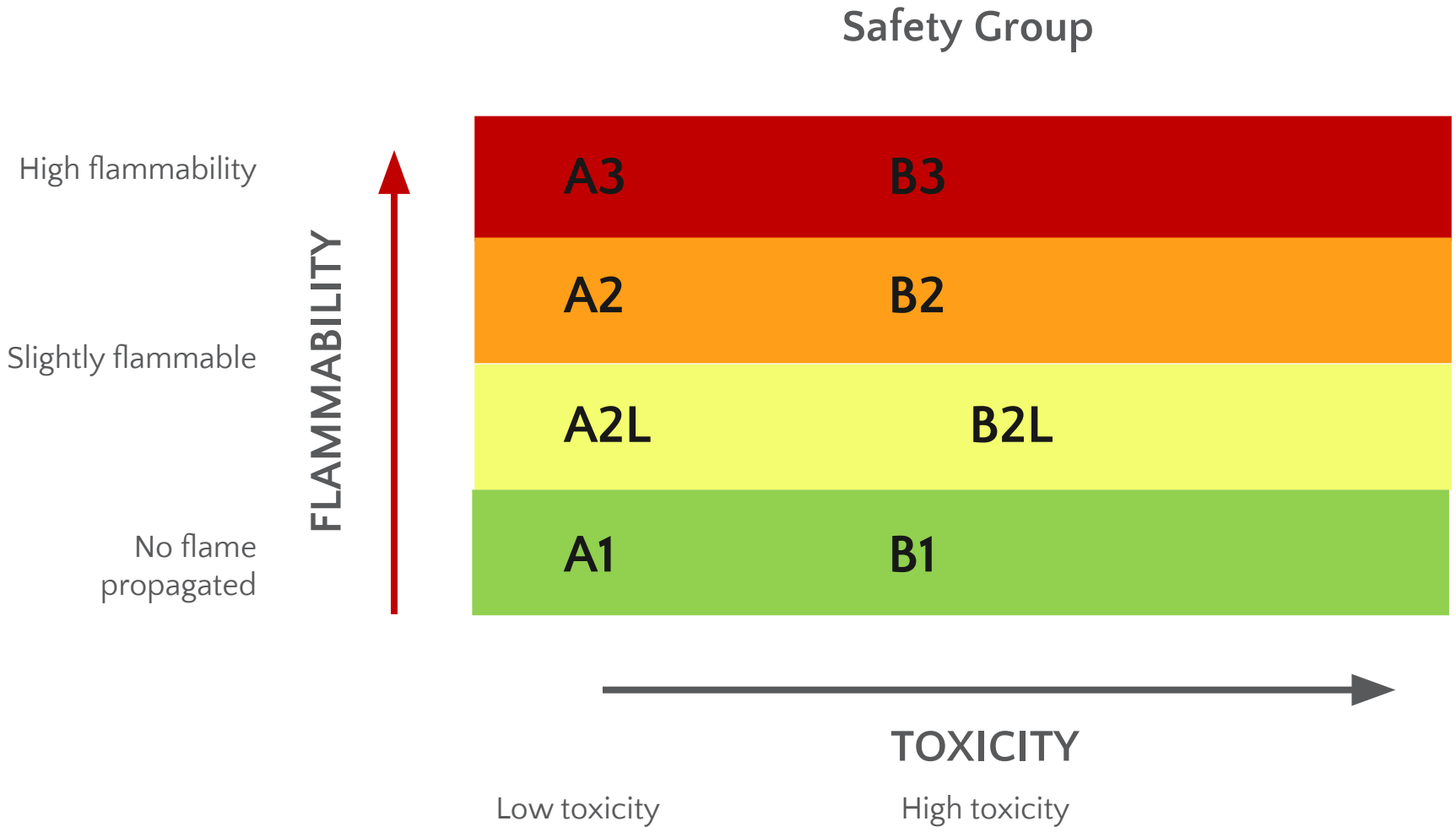
Ozone Depletion Potential

The relative impact of a substance as a depletion of the Earth's Ozone Layer.

ODP > 0 = BAD

…So substances with ODP's >0 have been regulated out of use through the Montreal Protocol.

ASHRAE Refrigerant Classifications



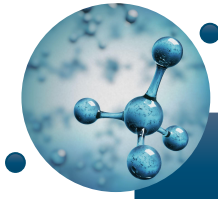
Refrigerants in the U.S.

2020 – American Innovation & Manufacturing Act

2016 – Kigali Amendment to the Montreal Protocol – HFCs

1997 – Kyoto Protocol – Climate Change

1987 – Montreal Protocol – CFCs & HCFCs

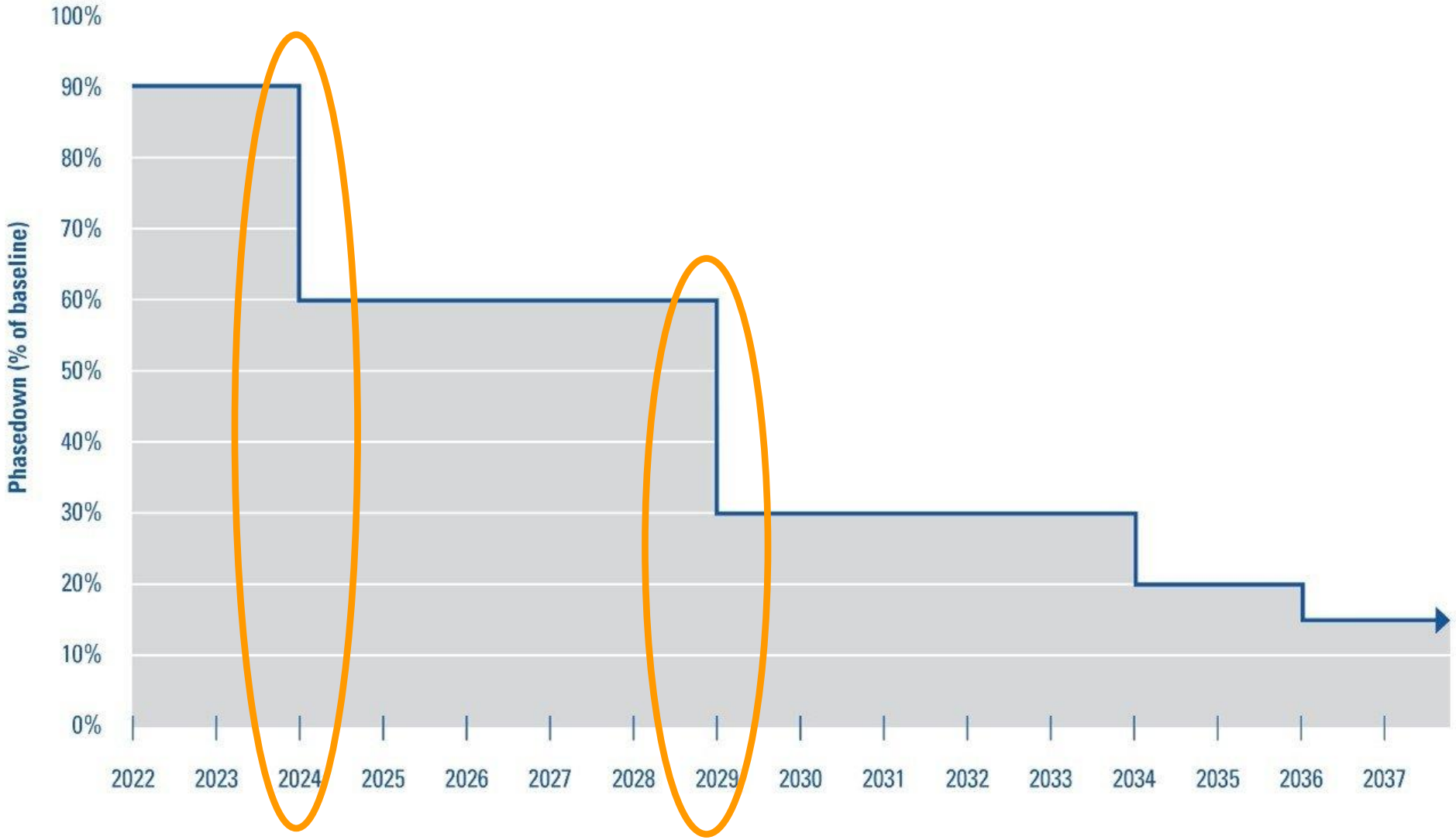


1930s/40s – Invention of Synthetic Refrigerants

1834 – Invention of Vapor Compression Cycle

American Innovation & Manufacturing (AIM) Act

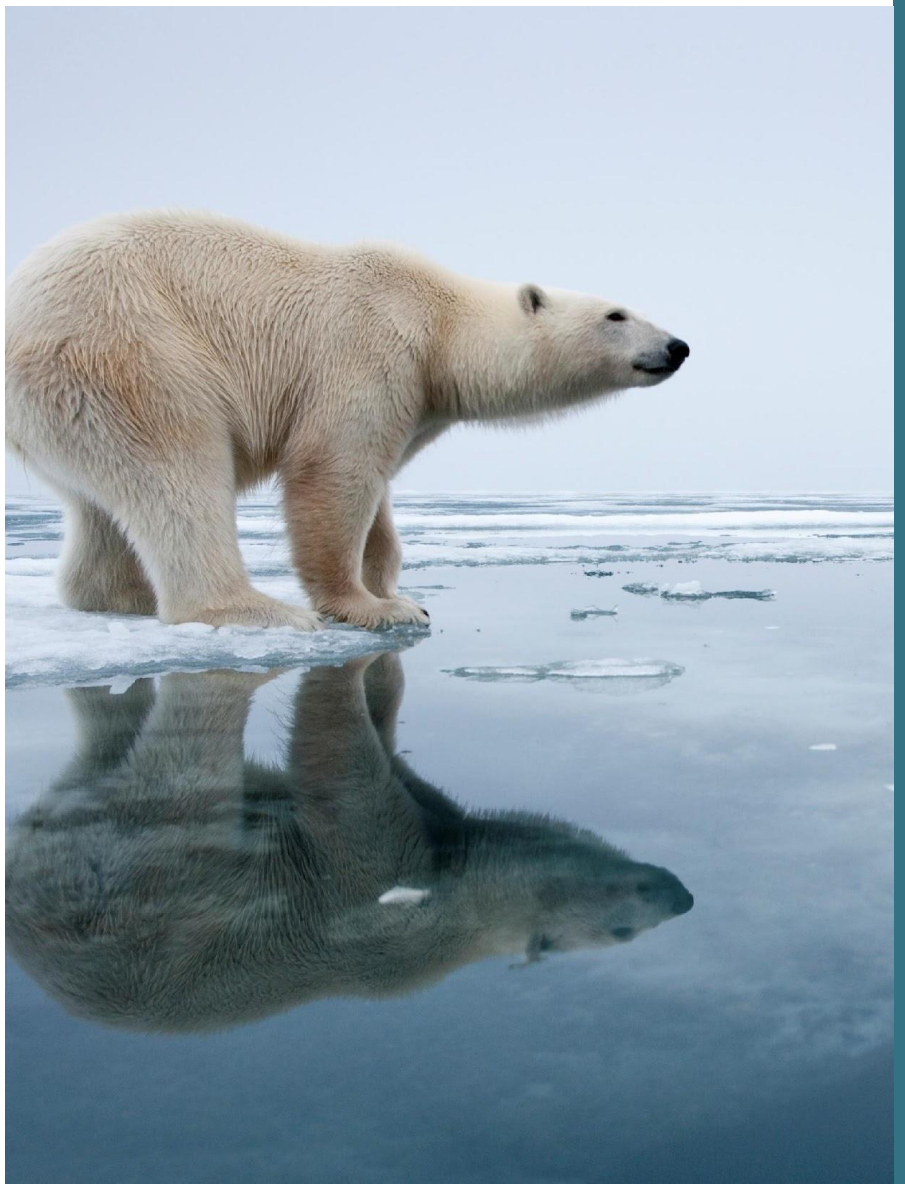
HFC Phasedown Schedule



https://www.epa.gov/climate-hfcs-reduction/final-rule-phasedown-hydrofluorocarbons-establishing-allowance-allocation

Example:
Residential Heat Pump (air-to-air)

Refrigerant	GWP	Safety Group
Synthetic Refrigerants		
R-410A	**2,088**	**A1**
R-32	675	A2L
R-454B	467	A2L
Natural Refrigerants		
R-290	3	A3



Refrigerant Stewardship:

What can you do?

1. New equipment/systems
   - Lower GWP
   - Minimize charge size

2. Leaks
   - Prevent
   - Detect
   - Repair

3. Reclaim at end of life

Brewery Systems that Use Refrigerants

Chillers

Coolers/cases

HVAC

Linked systems

Efficiency Vermont

Vermont:
Attractive place for Decarbonization

- High corporate & community interest in decarbonization
- Low-carbon-emissions electrical grid
- Widespread reliance on expensive propane and oil for thermal processes

Why not just Electrify already!?

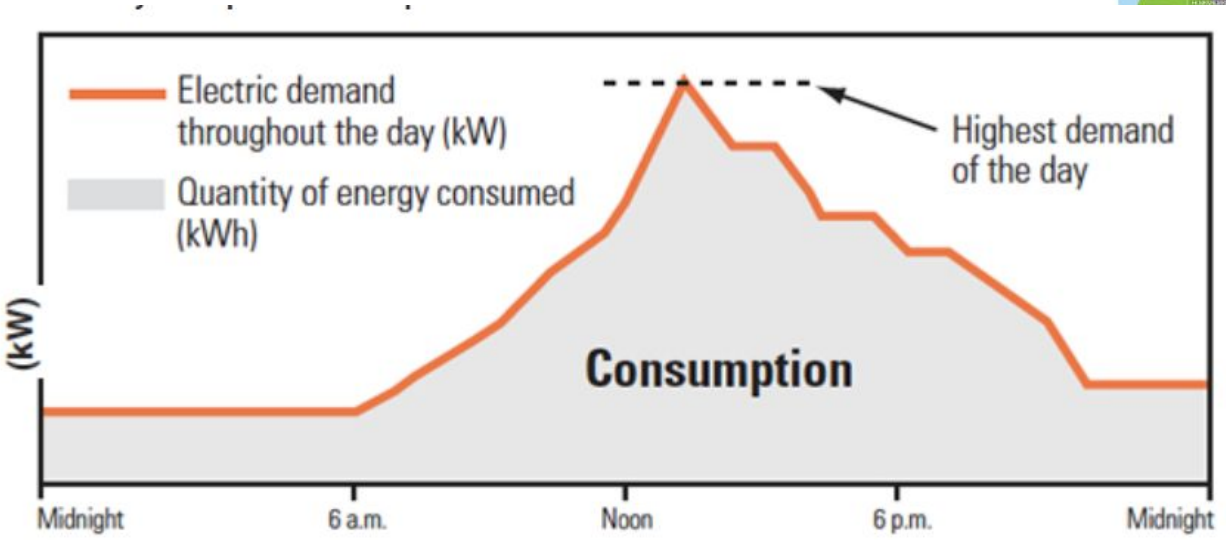
Oil/Propane/Nat Gas, 15 psi Steam boiler

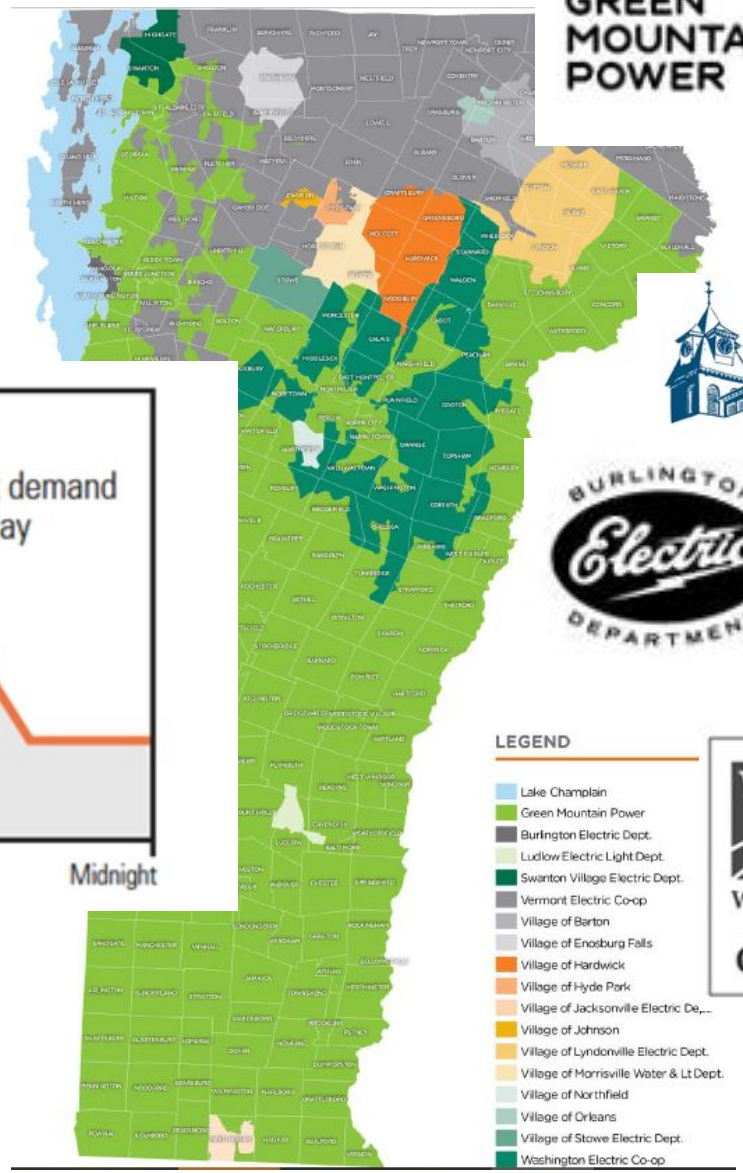
Electric , 15 psi Steam boiler

Reason 1.

$ HIGH Operating Cost $

ELECTRIC RATES
Energy AND Demand





Swanton VERMONT

TOWN OF LYNDON ELECTRIC DEPARTMENT

Village of Enosburg Falls

BVI BARTON VILLAGE

GREEN MOUNTAIN POWER

VERMONT ELECTRIC CO-OP

Village of Orleans, VT

Village of Johnson Water & Light

VILLAGE OF HYDE PARK

HARDWICK ELECTRIC DEPARTMENT HARDWICK, VERMONT

BURLINGTON Electric DEPARTMENT

STOWE ELECTRIC DEPARTMENT

Ludlow VERMONT

MORRISVILLE WATER & LIGHT

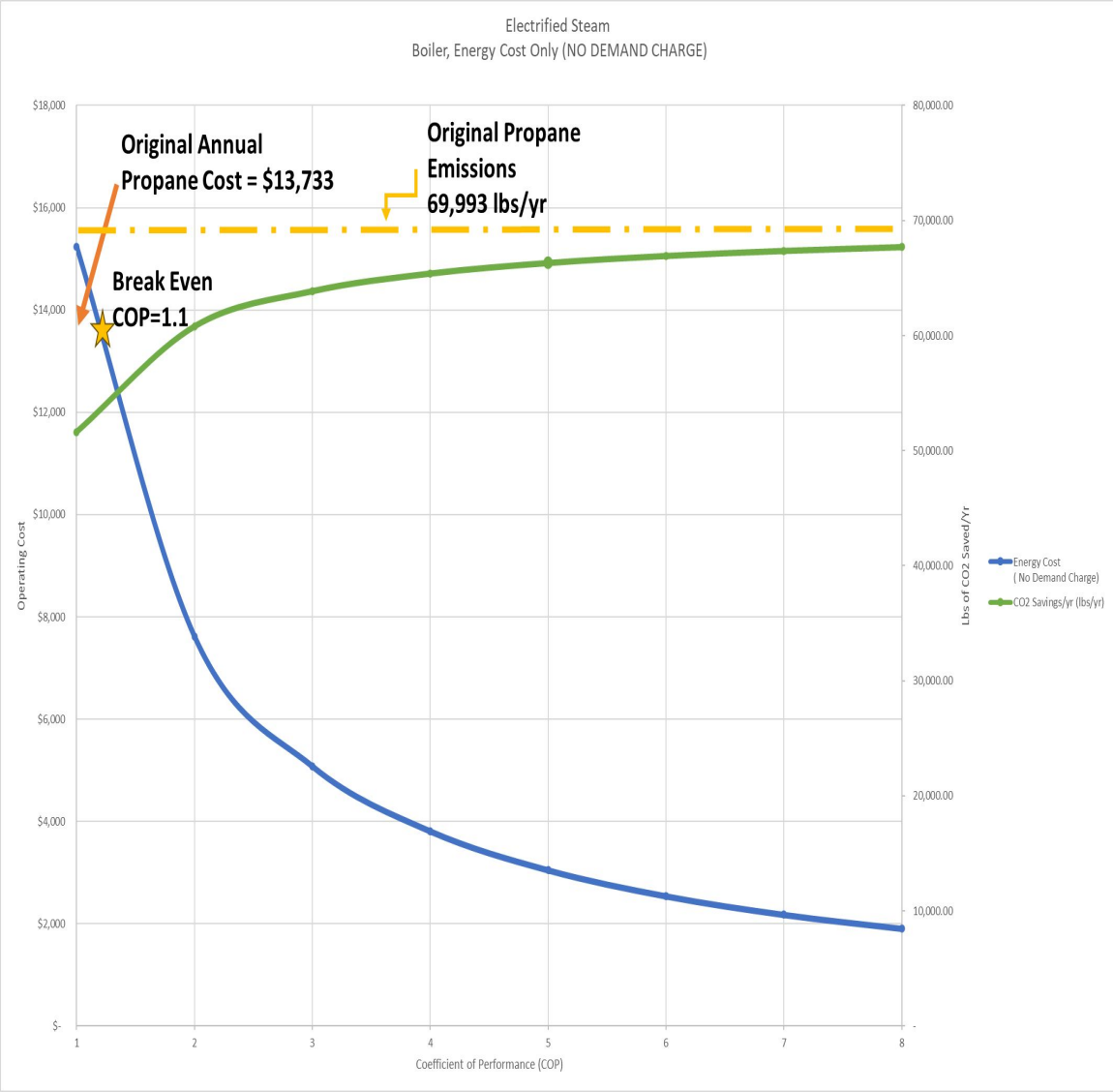
NORTHFIELD VERMONT

WEC Washington Electric CO-OP

Jacksonville Electric Co.

Municipal electric company for Jacksonville and Whitingham.

Operating Cost- Example, Propane vs Electric Energy (kWh) cost only



Steam, 15psi, 30 BHP (Boiler Horse Power) Propane or Electric

On Peak, 4, 120 minute batches per week, 52 Weeks per year

Propane Fired Baseline	Annual Cost		CO2 Lbs/yr	
	$ 13,733		**69,993**	
COP	Energy Cost (No Demand Charge)	Savings*	CO2 lbs/yr	CO2 Savings/yr (lbs/yr)
1	$ 15,241	$ (1,507)	18361	51,632.34
2	$ 7,620	$ **6,113**	9180	60,812.66
3	$ 5,080	$ **8,653**	6120	63,872.76
4	$ 3,810	$ **9,923**	4590	65,402.82
5	$ 3,048	$ **10,685**	3672	66,320.85
6	$ 2,540	$ **11,193**	3060	66,932.87
7	$ 2,177	$ **11,556**	2623	67,370.03
8	$ 1,905	$ **11,828**	2295	67,697.90

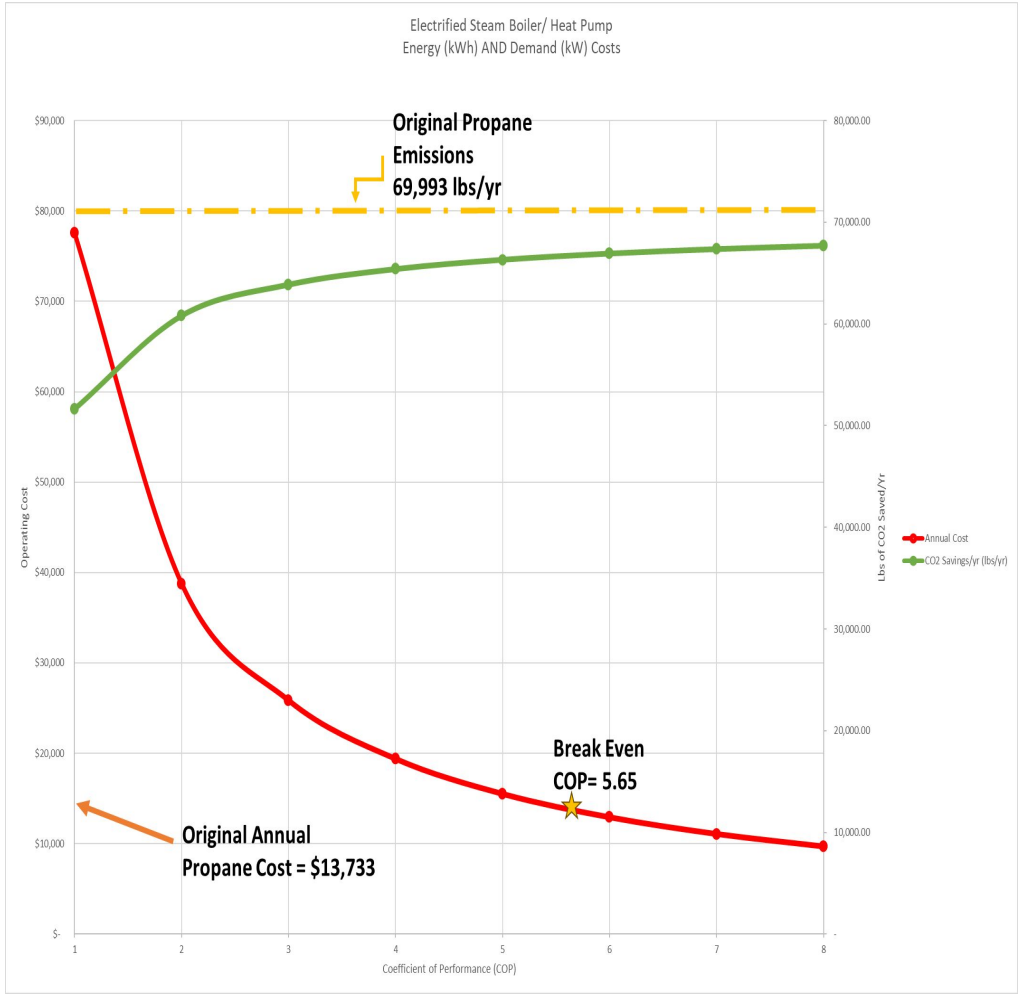
* Does not include Utility Demand Charges

Propane at $2.50/gallon

Electric, $0.12451/kWh

CO2 Emission from Grid 150lb/MWh

Operating Cost- Example,
Propane vs Electric Energy (kWh) cost AND Demand (kW)



Steam, 15psi, 30 BHP (Boiler Horse Power)
Propane or Electric

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Propane Fired Baseline		Annual Cost		CO2 Lbs/yr	
		$ 13,733		**69,993**	
COP	Energy Cost (No Demand Charge)	**Demand Charge**	**Annual Cost**	Actual Savings	CO2 lbs/yr	CO2 Savings/yr (lbs/yr)
1	$ 15,241	$ 62,306	$ 77,547	$ (63,813)	18361	51,632.34
2	$ 7,620	$ 31,153	$ 38,773	$ (25,040)	9180	60,812.66
3	$ 5,080	$ 20,769	$ 25,849	$ (12,116)	6120	63,872.76
4	$ 3,810	$ 15,577	$ 19,387	$ (5,653)	4590	65,402.82
5	$ 3,048	$ 12,461	$ 15,509	$ (1,776)	3672	66,320.85
6	$ 2,540	$ 10,384	$ 12,924	$ **809**	3060	66,932.87
7	$ 2,177	$ 8,901	$ 11,078	$ **2,655**	2623	67,370.03
8	$ 1,905	$ 7,788	$ 9,693	$ **4,040**	2295	67,697.90

Propane at $2.50/gallon
Electric, $0.12451/kWh and $17.646/kW Demand Charge
CO2 Emission from Grid 150lb/MWh

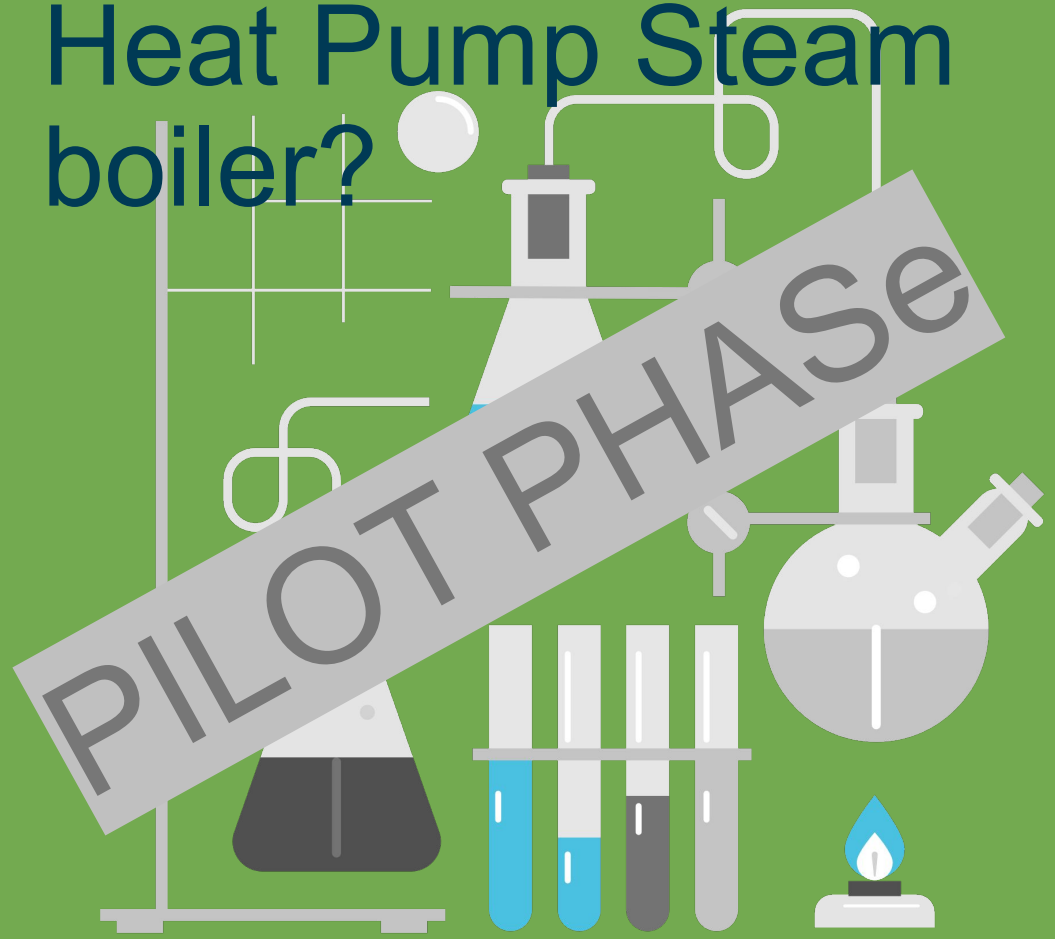
Why not just Electrify already!?

Reason 2.

Lack of Equipment

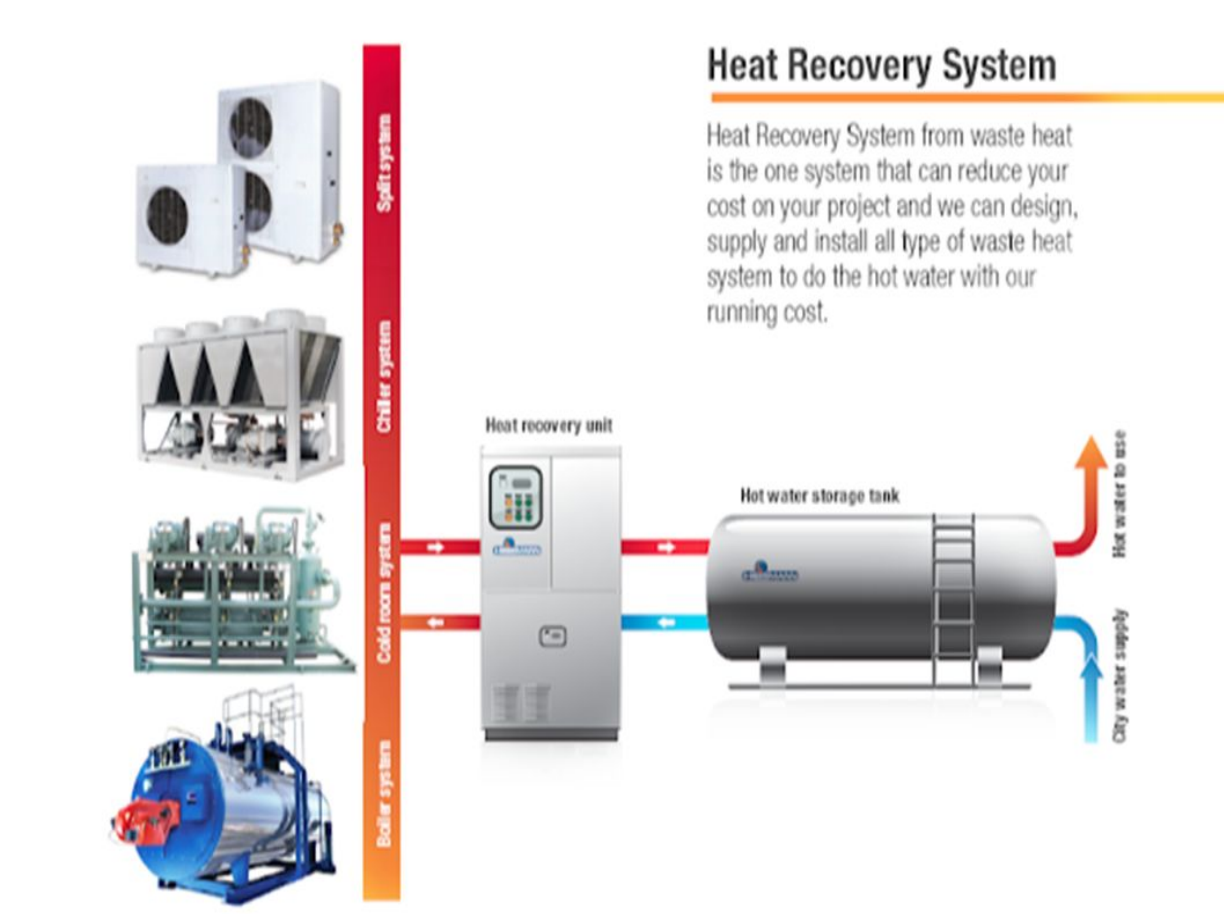
(And high “LIFT”= low efficiency)

Heat Pump Steam boiler?



SOLUTION: Process Integration is required

It’s no Widget



Decarbonization = Systems Thinking

Efficiency

The energy you don't need to use;

- Has no operating cost
- Has no emissions

Energy Recovery

Treat waste heat as a resource

- Cooling water, Refrig. & Chiller heat recovery
- Wastewater/CIP heat recovery

Storage

Combine storage to minimize costs

- Electric Storage
- Heat and Subcooled Liquid Storage
- Strategic sequencing of batches

Adjust Thermal Processes

Opportunity for Non-Fossil fuel

- Renewable Fuel Options
- Integrate heating and cooling
- Electrification- Consider scaling up heat-pump use

https://www.efficiencyvermont.com/products-technologi

Efficiency Vermont

Industrial & Special Equipment

Refrigeration & Commercial Kitchens

Heating, Cooling & Ventilation

Renewable Energy

Insulation & Air Sealing

Lighting

Appliances

Electronics

Transportation

Agricultural Equipment

Smart Homes

Questions?

Melissa Stewart
Senior Engineering Consultant
mstewart@veic.org

Pat Haller
Principal Engineering Consultant
phaller@efficiencyvermont.com

20 Winooski Falls Way, 5th Floor

Winooski, VT 05404

efficiencyvermont.com