

Energy & Store  
Development Conference

2016  
E+SD



THE VOICE OF FOOD RETAIL 

Energy & Store  
Development Conference

E+SD 2016

Electric vs. Gas Defrost,  
Which Cost More to Run?

# Abstract Summary

*“It has been thought for years that utilizing gas defrost on commercial refrigeration systems that operate in the temperature range below freezing was less expensive because compressors are always producing more gas than what was necessary for providing adequate mass flow and the electric defrost has that additional electric coil that used electricity to defrost the coil; therefore, gas defrost uses less energy.*

*This presentation will compare the same low temperature refrigeration system in several different US cities using electric vs gas defrost looking at the total cost of ownership across both applications to determine which defrost is truly the most cost effective for your business.”*

*Rivals from Beginning....*



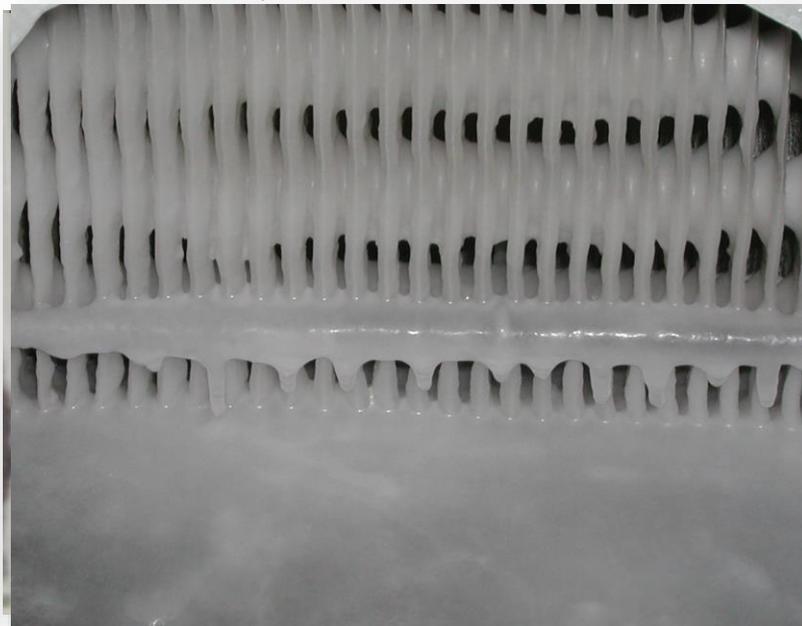
*And the discussion continues....*

## Defrost...

- What is it?
- Why is it used?
- What different types are there?
- When is it used?

## What is Defrost?

It is the removal of frost or ice from an evaporator coil in a refrigerated or frozen food case, meat cooler or freezer application.



## Why is Defrost used?

- During the refrigeration cycle, moisture from ambient air or from the product being refrigerated deposits itself on the coil (latent heat of condensation) and freezes. This frost or ice prevents proper air flow across the coil and air curtain velocities.

## Typical Methods of Defrost:

- *Electric*
- *Hot gas*
- Off-time

Note:

*The analysis will not include off-time defrost impact*

## Electric Defrost Operation:

The refrigerant flow is shut off, typically time initiated, electric current is applied to a resistance heater that is affixed to the evaporator coil or is placed between the fans and the coil. Defrost is then terminated by temperature or pre-determined time sequence.



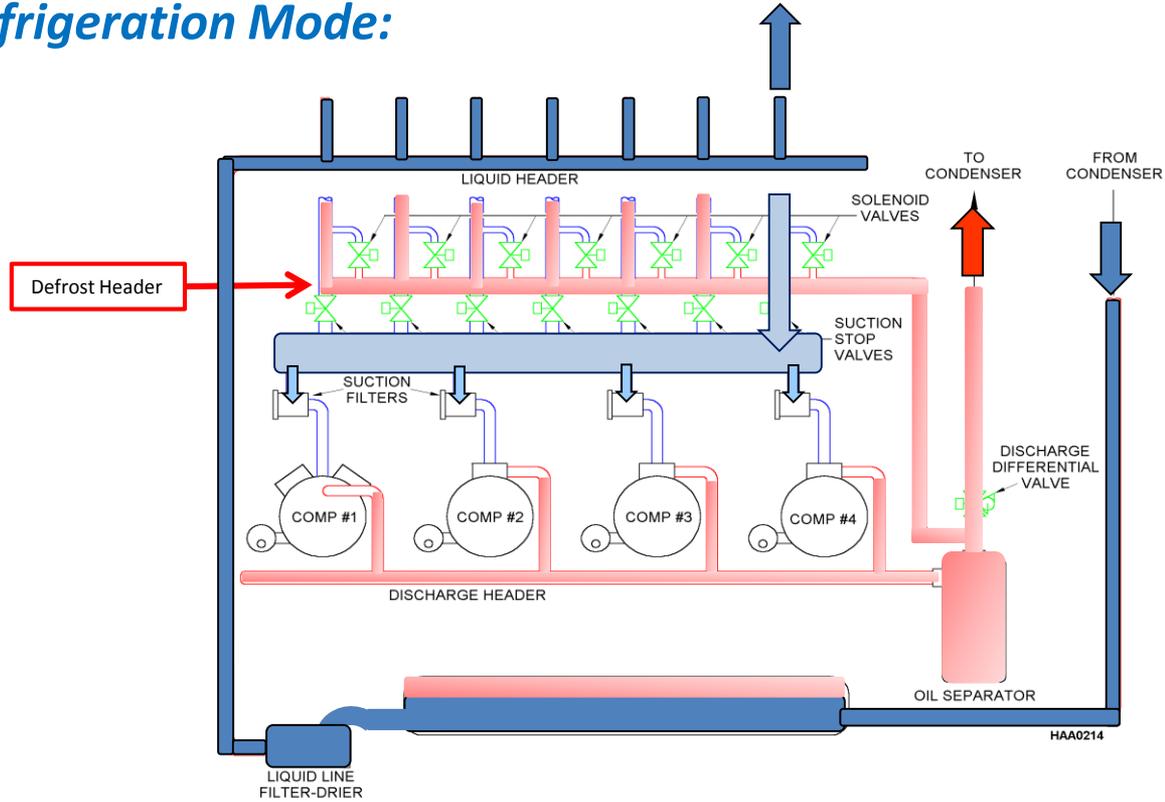
**Electric Defrost  
Heating Element**

## Gas Defrost Operation:

Refrigerant flow is shut off, typically time initiated, superheated discharge gas from the compressor is directed to the evaporator coil to provide heat for defrost. Defrost is then terminated by temperature or pre-determined time sequence. Refrigeration re-engaged.

# Hot Gas Rack-

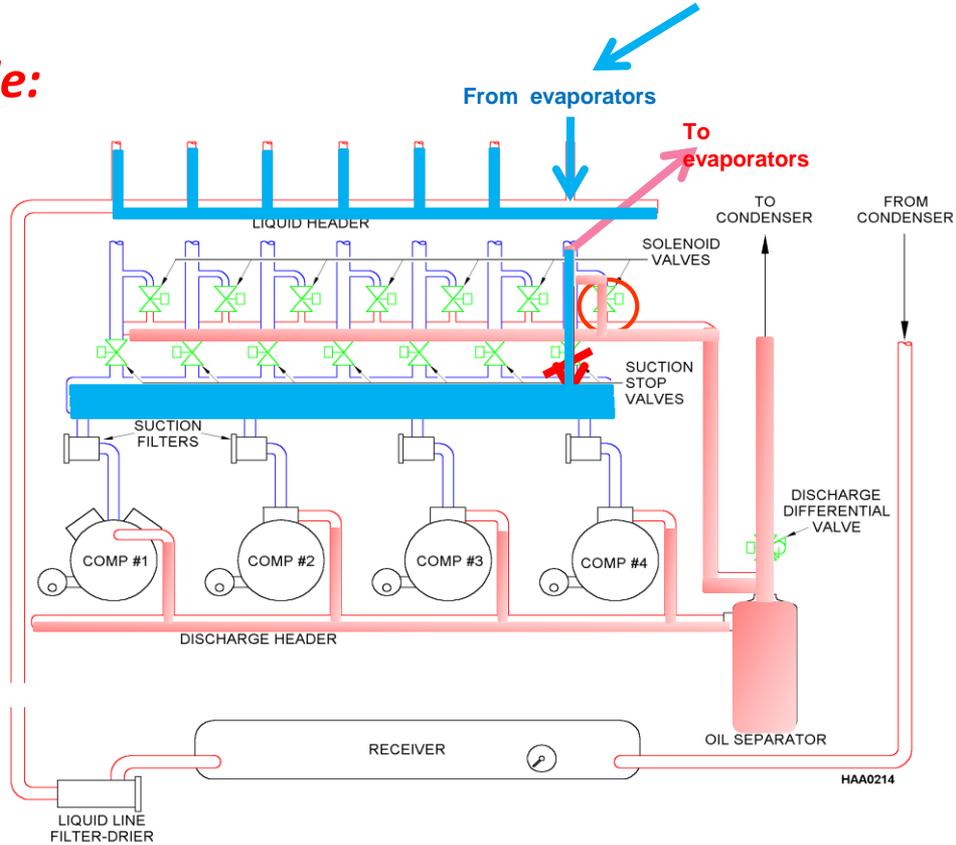
## Refrigeration Mode:



BASIC PARALLEL RACK SYSTEM WITH "HOT GAS" DEFROST

# Hot Gas Rack-

## Defrost Mode:



BASIC PARALLEL RACK SYSTEM WITH "HOT GAS" DEFROST

## ***Many Factors to Consider in the Defrost Decision:***

- Initial Cost
  - Equipment and Installation
- Geographic Location
- Contractor Base
  - Technical Knowledge/Cost to Service
- System Design and Piping Layout
- Control Methodology
- Utility Rate Structures/Rebates/Incentives
- Heat Reclaim Needs
- Store/Operating Personnel
- On-going Maintenance
- Future Expansion and Renovations

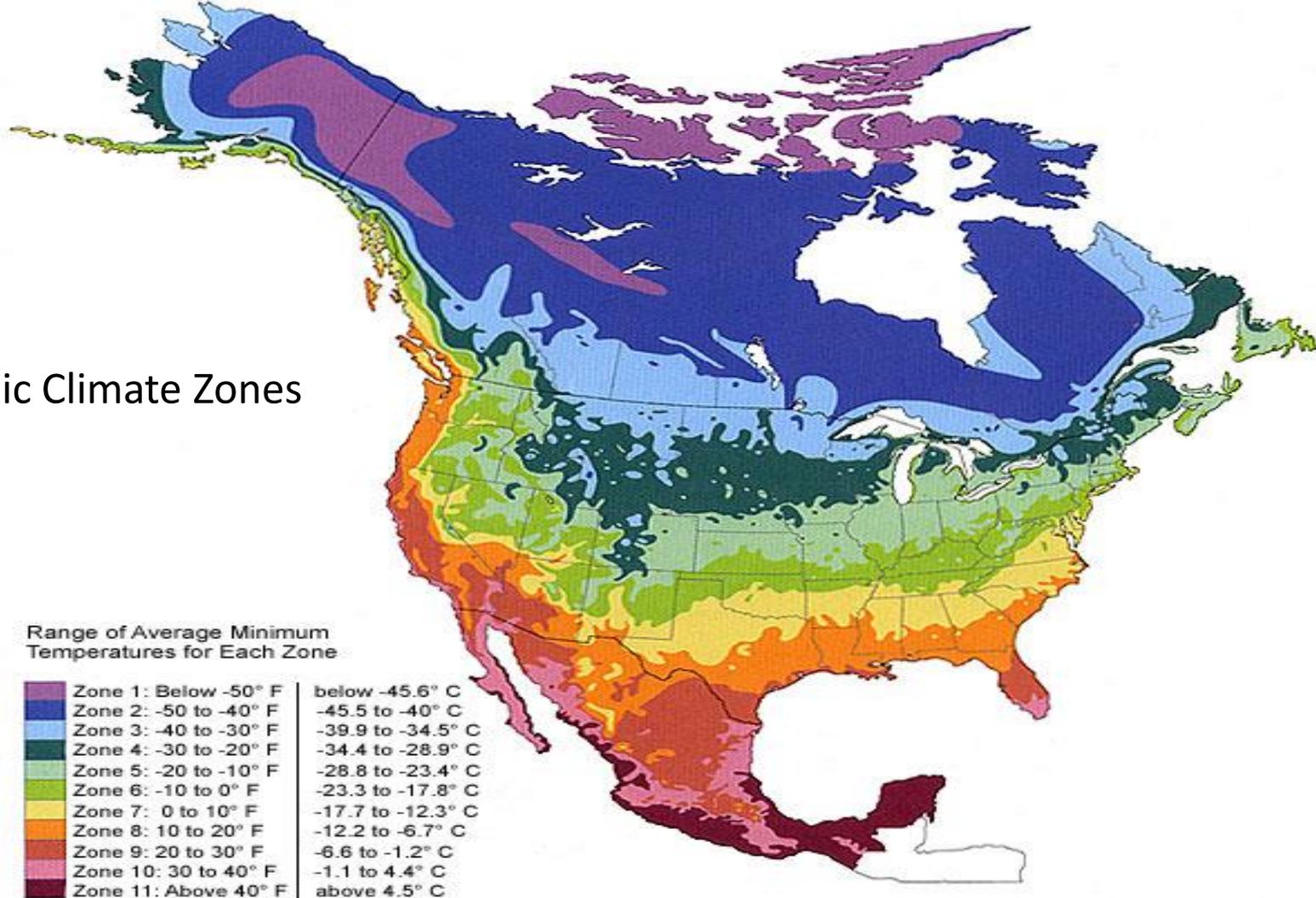
## Baseline Analysis Criteria:

- Utilize 50,000 sq. ft. supermarket layout
- (9) Geographic Regions in North America
- Equipment loads:
  - (1) Low Temp R407A DX Rack (-23 Suction Temperature)
- Operating Parameters:
  - Minimum Condensing Temperatures
    - 70 & 80 degree F for Hot Gas Defrost
    - 50 degree F for Electric Defrost
  - Ambient Conditions-geographically based
  - Defrost-time initiated/time terminated
- Utility Rate Structures-region based
- Multiple Circuit and Loop Piping Arrangements

## Baseline Load Criteria:

SYS #	DISPLAY CASE / UNIT COOLER		DIS AIR	REQ'D CAP	EVP
	SIZE	DESCRIPTION	TMP	(MBH)	TMP
1	12'x30'x10'	FROZEN FOOD FREEZER	-12	23.50	-20
2	16'x20'x10'	BAKERY FREEZER	-5	20.10	-15
3	4	ISLAND ICE CREAM	-10	4.24	-15
4	9'x18'x10'	DELI FREEZER	-5	12.40	-15
5	5 DOORS	REACH-IN ICE CREAM	-10	5.30	-15
6	12 DOORS	REACH-IN FROZEN FOOD	-3	12.17	-7
7	14 DOORS	REACH-IN FROZEN FOOD	-3	14.20	-7
8	15 DOORS	REACH-IN ICE CREAM	-10	15.90	-15
9	12 DOORS	REACH-IN FROZEN FOOD	-3	12.17	-7
10	15 DOORS	REACH-IN FROZEN FOOD	-3	15.21	-7
11	10 DOORS	REACH-IN ICE CREAM	-10	10.60	-15
12	15 DOORS	REACH-IN FROZEN FOOD	-3	15.21	-7
13	12 DOORS	REACH-IN FROZEN FOOD	-3	12.17	-7
14	10 DOORS	REACH-IN FROZEN FOOD	-3	10.14	-7
15	1	ICE FLAKER		10.50	-5
16	10'x20'x10'	MEAT FREEZER	-5	14.40	-15
17	8 (8+1)	FROZEN MEAT ISLAND	-12	6.36	-20
18	32 (12, 8, 12 + 2)	FROZEN MEAT ISLAND	-12	21.20	-20
19		SPARE			
		<b>TOTAL</b>		<b>235.76</b>	

## Geographic Climate Zones



## Primary Equipment and Install Criteria

- Initial Equipment Costs
  - Rack-electric defrost panel(s)/hot gas headers, etc.
  - Cases/Walk-in boxes-components
- Installation Costs
  - Electrical-wiring and components
  - Refrigeration-Refrigerant charge, piping methods
- Operating Costs
  - Heat reclaim excluded
- Maintenance Impact
  - Service Capabilities/Technical Competency
  - Future renovations
  - Refrigerant Selection and Charge
- Total Cost of Ownership

## Equipment Cost Comparison:

Capital Costs - Electric Defrost Compared to Hot Gas Baseline		
Impact	Component	Delta
Equipment	Increase cost to add heaters to cases and evaporator coils	\$ 1,300.00
Equipment	Increase cost for defrost panel (breakers, contractors, panel)	\$ 5,200.00
Equip	Decrease cost for removing defrost regulating valves, HG piping, HG solenoids	\$ (6,700.00)
Install	Decrease for removing line sizing/evap. manifolds for hot gas returns	\$ (3,500.00)
Install	Increase wiring pulls from defrost panel to cases (17 feeds ~30A each)	\$ 17,000.00
<b>Total Capital Costs Delta Compared to Hot Gas Baseline</b>		<b>\$ 13,300.00</b>

*What are some options to offset capital costs?...*

## ***Optional Loop Piping-(50,000 sq.ft. store-Low Temp Rack only):***

### **Reduced Refrigerant Charges/Potential For Leaks**

- 225% Reduction In Overall Pipe Length
- 550% Reduction In Overall Quantity Of Fittings
- 13% Reduction In Quantity Of Refrigerant Required

### **Pounds Of Refrigerant Required:**

Loop Piping System:

1,300 lbs.

Multiple Circuit Piping:

1,500 lbs.

**13% Reduction In Refrigerant Charge**

### **Pipe Length Required**

<u>Loop System</u>		<u>Multiple Circuit System</u>	
2 5/8"	365	2 5/8"	0
2 1/8"	365	2 1/8"	200
1 5/8"	335	1 5/8"	965
1 3/8"	265	1 3/8"	1100
1 1/8"	600	1 1/8"	1435
7/8"	835	7/8"	765
5/8"	365	5/8"	1665
1/2"	835	1/2"	3000
<b>TOTAL:</b>	<b>3,965</b>	<b>TOTAL:</b>	<b>9,130</b>

**225% Reduction In Pipe Length**

### **Fittings Required**

<u>Loop System</u>		<u>Multiple Circuit System</u>	
2 5/8"	35	2 5/8"	0
2 1/8"	40	2 1/8"	25
1 5/8"	45	1 5/8"	105
1 3/8"	40	1 3/8"	180
1 1/8"	85	1 1/8"	205
7/8"	140	7/8"	110
5/8"	55	5/8"	215
1/2"	130	1/2"	385
<b>TOTAL:</b>	<b>570</b>	<b>TOTAL:</b>	<b>1,225</b>

**550% Reduction In Fittings**

## Hot Gas System Ongoing Maintenance Impact Factors:

- Refrigerant Leaks-R407A @\$10/lb.(no labor)  
Annual leak rate reduction utilizing electric defrost:  
1,500 lbs. x 2.5% x 15 years=\$5,625  
1,500 lbs. x 5% x 15 years=\$11,250  
1,500 lbs. x 10% x 15 years=\$22,500
- Equipment Wear and Tear
- Future Facility Renovations
- Technical Service Competency

## Annual Energy Cost Comparison

Climate Zone	Geographic Location	Power Use (kWh)		Cost/kWh	Annual Impact-Electric vs. Hot Gas 80F cond.			Hot Gas 70 F cond.
		Hot Gas 80F cond.	Electric 50F cond.		kWh Delta	Cost	Percentage	
9	Los Angeles, CA	237,511	229,673	\$0.21	-7,838	-\$1,646	-3.30%	7.94%
9	Miami, FL	282,508	299,676	\$0.09	17,168	\$1,497	6.08%	7.04%
7	Atlanta, GA	257,140	245,633	\$0.09	-11,507	-\$1,069	-4.48%	3.71%
6	Seattle, WA	228,798	200,116	\$0.11	-28,682	-\$3,098	-12.54%	1.32%
5	New York, NY	246,112	222,691	\$0.18	-23,421	-\$4,122	-9.52%	0.98%
5	Chicago, IL	243,774	214,943	\$0.15	-28,831	-\$4,354	-11.83%	-1.10%
2	Winnipeg, MB	219,383	190,621	\$0.08	-28,762	-\$2,301	-13.11%	-3.76%
4	Montreal, QC	222,453	196,531	\$0.10	-25,922	-\$2,592	-11.65%	-2.62%
3	Calgary, AB	215,608	182,958	\$0.08	-32,650	-\$2,612	-15.14%	-5.14%

### **Highlights:**

- ***Ambient temperature has significant impact on energy consumption***
- ***Minimum condensing temperature control is crucial***

## Summary of Electric Defrost Features:

### Pros:

- Less refrigerant leak potential due to reduction pipe expansion and contraction
- Installation could be considered less complicated, no evaporator manifold needed
- More consistent defrost temperature year round
- Future system/case renovations less complex, hot gas return not required
- Ability to utilize loop ping arrangement

### Cons:

- Can increase display case maintenance
- Initial equipment cost
- Increased energy consumption potential

## Summary of Hot Gas Defrost Features:

### Pros:

- Utilizes available heat/energy for defrost requirements
- Shorter defrost cycle
- Eliminates need for wiring and components for defrost heaters

### Cons:

- Required to artificially boost head pressures
- Higher refrigerant leak potential due to expansion and contraction
- Load balancing required to ensure hot gas is produced
- Limits ability for loop piping arrangement
- Can introduce additional moisture in display area
- Challenging for newer technicians

## Additional Recommendations to Improve Defrost Operation:

- **Facility Humidity Control**
  - Standard Guidelines: 75 degree dry bulb/55% RH=58F dew point
- **HVAC Air Flow Patterns**
  - Interference with display case operation/air curtain flow pattern
- **Demand Defrost**
  - Proper facility climate and dewpoint control increases positive impact
- **EEV's/Case Controls**
  - Allows for tighter case control, improved efficiency and remote operation
  - Allows for the use of floating suction pressure control-Increases suction pressure 3-5 PSI above design;  
(Equates to a 2% savings total refrigeration electrical consumption for every pound of pressure increase above design)

*What's right for your organization?*

**GAGOO!**



*A modification could be in your future.....*

The logo for the Energy & Store Development Conference 2016 is set against a dark green background. The text 'Energy & Store Development Conference' is in a white, sans-serif font. Below it, 'E+SD' is written in a much larger, bold, white font. To the right of 'E+SD', the year '2016' is displayed in a white, sans-serif font. The right side of the image features a blue and green abstract graphic with technical lines and shapes, suggesting a high-tech or industrial theme.

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Thank you....questions?