



Ultra-Cool Heat Recovery & Natural Refrigerants

Climate-friendly NHL arenas, grocery stores and food warehouses.

Natural refrigerants that reduce ozone depletion and greenhouse gas emissions.

Status update on the international Montreal Protocol & Kigali Amendment.

Fri Nov 20, 2020 | 11:00 AM - 12:00 PM ET



Clean Air Partnership

CLIMATE SOLUTIONS WEBINAR SERIES



BRUCE (BF) NAGY CLIMATE SOLUTIONS

- Columnist & features
- Consultant
- Author 200+ articles on climate solutions
- Author *The Clean Energy Age*, Rowman & Littlefield



Climate solutions
Expert best practices
Case examples
Clear priorities



SOLUTIONS, PRIORITIES, CASE EXAMPLES



BUILDINGS

NEW & RETROFIT TECHNOLOGY & PROGRAMS



TRANSPORTATION

ELECTRIC FLEETS, INFRASTRUCTURE & TRANSIT VEHICLES



POWER GENERATION & STORAGE

TECHNOLOGY, PLANNING & ECONOMICS

TODAY

1. REFRIGERANTS & NATURAL REFRIGERANTS
BACKGROUND
2. MONTREAL PROTOCOL
KIGALI AMENDMENT FOR HFC PHASE DOWN
RECENT REGULATORY DEVELOPMENTS
3. CLIMATE-FRIENDLY
CASE EXAMPLES
4. QUESTIONS

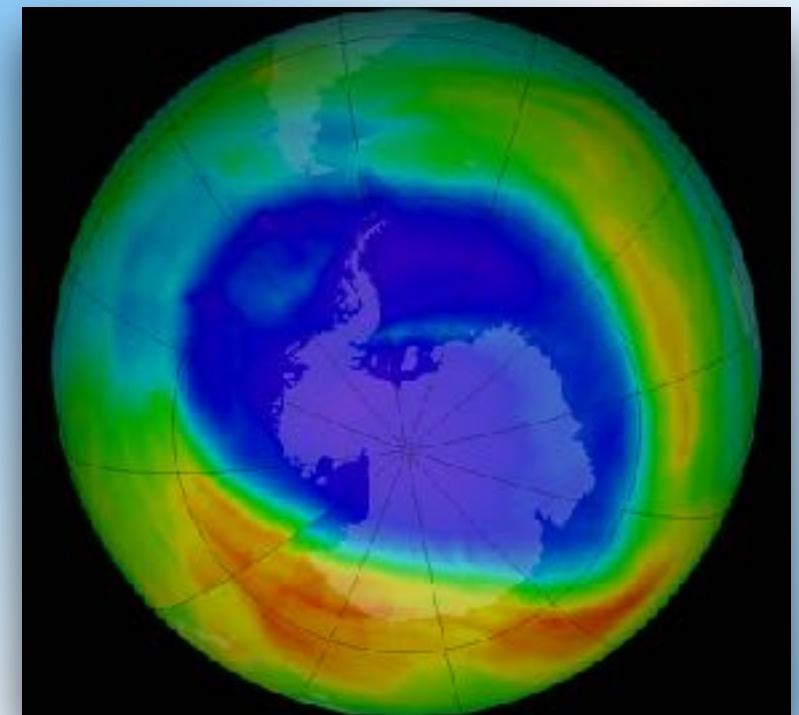


WHY DO REFRIGERANTS MATTER?

REFRIGERANTS IN THE ATMOSPHERE
HAVE TWO SERIOUS
ENVIRONMENTAL IMPACTS:

- OZONE LAYER DEPLETION
- GLOBAL HEATING

ALTHOUGH THEY ARE SUPPOSED TO BE KEPT IN
SEALED CONTAINMENT FOR REFRIGERATION,
COOLING & ICE-MAKING, THE REALITY IS THAT LOSSES
TO THE ATMOSPHERE HAVE BEEN SHOWN TO BE
UP TO 30% PER YEAR (REFRIGERATED TRUCKS
UP TO 50%, MARINE 39%).



ODP & GWP

- **ODP** OZONE DEPLETION POTENTIAL
- **GWP** GLOBAL WARMING POTENTIAL

ODP - MONTREAL PROTOCOL 1987

PHASE OUT HCFCs

GWP - KIGALI AMENDMENT 2019

PHASE OUT HFCs

Natural Refrigerants vs. HFCs & Blends

| | Refrigerant | Ozone depletion potential (ODP) | Global warming potential (GWP) | |
|---------|------------------------------------------|---------------------------------|--------------------------------|---------|
| NATURAL | R-717 Ammonia - NH ₃ | 0 | 0 | NATURAL |
| | R-744 Carbon Dioxide - CO ₂ | 0 | 1 | |
| | R290 Propane | 0 | 3 | |
| | R-718 Water - H ₂ O | 0 | 0 | |
| | R-729 Air | 0 | 0 | |
| | R-12 Dichlorodifluoromethane | 1.0 | 2400 | |
| | R-13 B1 Bromochlorofluoromethane | 10 | 6290 | |
| | R-22 Chlorodifluoromethane | 0.05 | 1700 | |
| | R-32 Difluoromethane | 0 | 650 | |
| | R-113 Trichlorotrifluoroethane | 0.8 | 4800 | |
| | R-114 Dichlorotetrafluoroethane | 1.0 | 0.9 | |
| | R-123 Dichlorotrifluoroethane | 0.02 | 0.02 | |
| | R-124 Chlorotetrafluoroethane | 0.02 | 820 | |
| | R-125 Pentafluoroethane | 0 | 3400 | |
| | R-134a Tetrafluoroethane | 0 | 1300 | |
| | R-143a Trifluoroethane | 0 | 4300 | |
| | R-152a Difluoroethane | 0 | 120 | |
| | R-245a Pentafluoropropane | 0 | 1000 | |
| | R-401A (53% R-22, 34% R-124, 13% R-152a) | 0.037 | 1100 | |
| | R-401B (51% R-22, 28% R-124, 11% R-152a) | 0.04 | 1200 | |
| | R-402A (36% R-22, 60% R-125, 2% R-280) | 0.02 | 2600 | |
| | R-404A (44% R-125, 52% R-143a, R-134a) | 0 | 3300 | |
| | R-407A (20% R-32, 40% R-125, 40% R-134a) | 0 | 2000 | |
| | R-407C (28% R-32, 25% R-125, 52% R-134a) | 0 | 1600 | |
| | R-502 (48.8% R-22, 51.2% R-115) | 0.283 | 4.1 | |
| | R-507 (45% R-125, 55% R-143) | 0 | 3900 | |
| | BluoTdx 20 (R458A) | 0 | 1554 | |
| | R-1234yf (vehicle A/C) | 0 | 1430 | |

Includes data from engineeringtoolbox.com

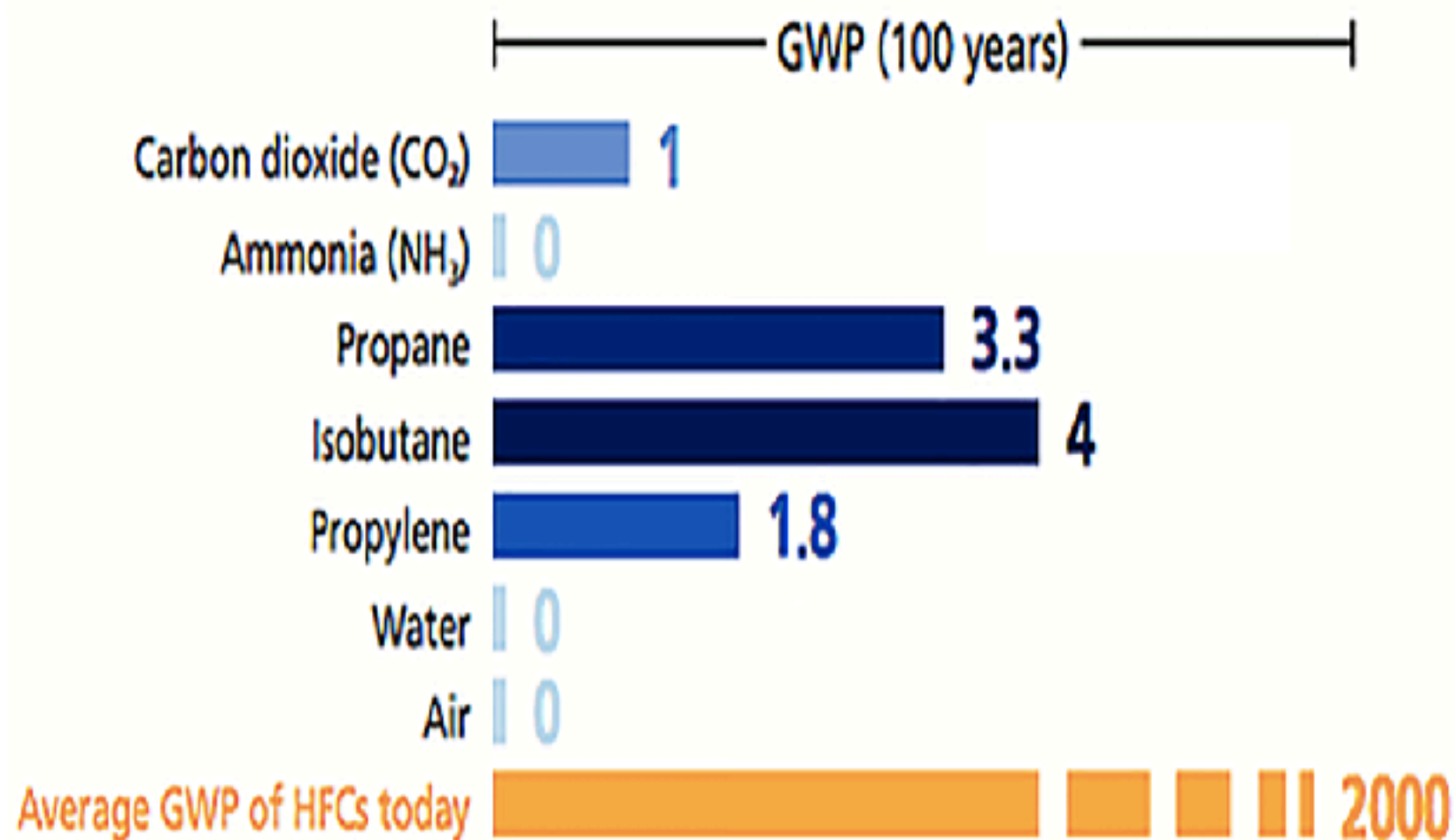
HFCs, BLENDS & NATURAL REFRIGERANTS

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| | R-744 Carbon Dioxide - CO ₂ | 0 | 1 |
| | R290 Propane | 0 | 3 |
| | R-718 Water - H ₂ O | 0 | 0 |
| | R-729 Air | 0 | 0 |
| R-12 Dichlorodifluoromethane | | 1.0 | 2400 |
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| R-114 Dichlorotetrafluoroethane | | 1.0 | 3.9 |
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| R-124 Chlorotetrafluoroethane | | 0.02 | 620 |
| R-125 Pentafluoroethane | | 0 | 3400 |
| R-134a Tetrafluoroethane | | 0 | 1300 |

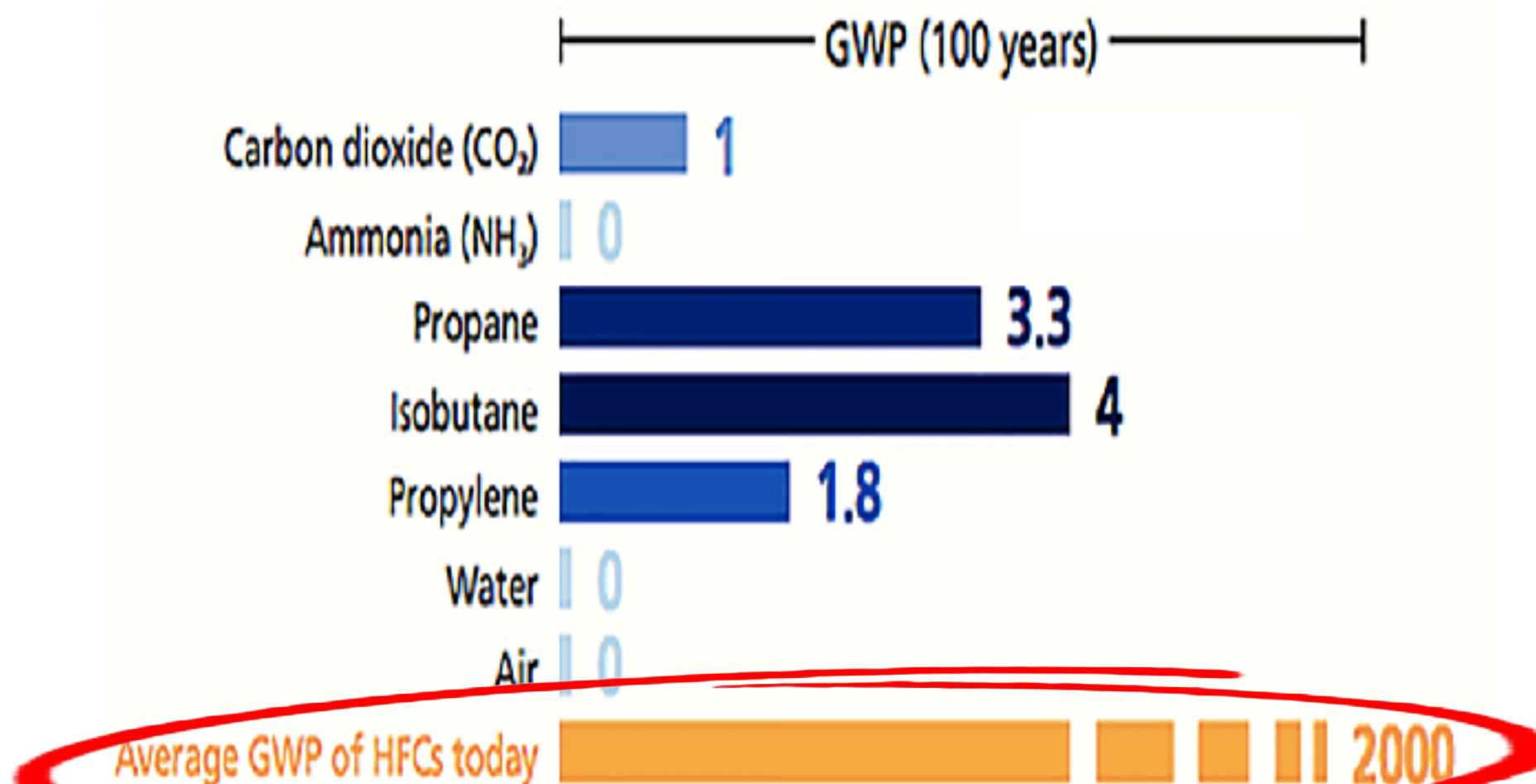
GWP OF HFCs & NATURAL REFRIGERANTS

GWP of natural refrigerants



GWP OF HFCs & NATURAL REFRIGERANTS

GWP of natural refrigerants



MODERN ADOPTION OF NATURAL REFRIGERANTS

GWP of natural refrigerants

— GWP (100 years) —

Carbon dioxide (CO₂) 1

Ammonia (NH₃) 0

Propane 3.3

Isobutane 4

Propylene 1.8

Water 0

Air 0

Average GWP of HFCs today 2000

**BECOMING WIDELY
ADOPTED**

TREATY RATIFICATION & IMPLEMENTATION

MONTREAL PROTOCOL 1987

PHASE OUT HCFCs

RATIFIED BY 197 COUNTRIES

CANADA WAS A LEADER

OUR PHASE DOWN MODEL

STUDIED & COPIED

KIGALI AMENDMENT EFFECTIVE 2019

PHASE OUT HFCs

RATIFIED BY 111 COUNTRIES

CANADA 2018 - 85% PHASED OUT BY 2036

REDUCTIONS 2019, 2024, 2029, 2034



OUR PARTIAL SUCCESS PHASING OUT HCFCs PROVES THE WORLD CAN WORK TOGETHER ON THE ENVIRONMENT.

OZONE DAMAGE BEGINNING TO BE REPAIRED.

HFC PHASE DOWN DIFFICULTIES

KIGALI AMENDMENT EFFECTIVE 2019

PHASE OUT HFCs

RATIFIED BY 111 COUNTRIES

INCLUDING CANADA

**USA WAS ON TRACK TO RATIFY BUT CURRENT
ADMINISTRATION CREATED ROADBLOCKS
AFTER MEETING WITH CHEMICAL COMPANIES**

**NEVERTHELESS IN OCTOBER 2020 SENATE
ANNOUNCED BI-PARTISAN AGREEMENT
BILL NOT YET PASSED**



HFC PHASE DOWN ECONOMICS

USA EQUIPMENT MANUFACTURERS WANT RATIFICATION & NATIONAL STANDARDS - THEY'RE LOSING MARKET SHARE TO EURO & ASIAN COMPETITORS

USA CHEMICAL COMPANIES WANT DELAYS

USA DISTRIBUTORS WANT STANDARDS FOR SMOOTH SUPPLY CHAIN

USA TRADE GROUPS & INSTALLERS WANT TRAINING FINALIZED

SOME STATE GOVERNMENTS STOPPED WAITING FOR NATIONAL RULES AND PASSED THEIR OWN LAWS, CREATING PATCHWORK



NATURAL REFRIGERANT SUCCESS STORIES

- GROCERY STORES
- REFRIGERATED WAREHOUSES
- ARENAS
- (• NOT COVERED TODAY: CO₂ HEAT PUMPS FOR AC AND WATER HEATING)

RETAIL SETTINGS: 4 TRENDS HAVE TAKEN HOLD

1 R290 PROPANE BASED STANDALONE REFRIGERATION CASES

2 CARBON DIOXIDE (CO₂) – BASED TRANSCRITICAL SYSTEMS FOR SUPERMARKET RACK REFRIGERATION

3 ENERGY RECOVERY, ALSO FOR RACK REFRIGERATION.

4 MORE RECENT AND MORE SUCCESSFUL:

CO₂/AMMONIA (MUCH LOWER CHARGE) HYBRID SYSTEMS

WAREHOUSES: 2-4 ABOVE

ARENAS: MOSTLY AMMONIA, SOME CO₂



**STANLEY CUP
WINNING ICEMAKING**



NATURAL REFRIGERANT SUCCESS STORIES

THE WORLD'S BIGGEST RETAILERS AND FOOD AND BEVERAGE MANUFACTURERS HAVE BEEN TESTING NATURAL REFRIGERANTS SINCE THE EARLY 2000S, AND SINCE APPROXIMATELY 2010 THEY HAVE MOVED BEYOND PILOT PROJECTS, UNDERTAKING MASS ROLLOUTS OF SUCCESSFUL NATURAL REFRIGERANT SYSTEMS.

MORE INFO: TRIPLEWINADVISORY.COM/FEATURED/THE-UP-AND-UP-ON-NATURAL-REFRIGERANTS

RETAIL STORES - R290 PROPANE REFRIGERATION CASES
30% SAVING ON OPERATING COSTS, COMPARABLE GHG REDUCTION



WHOLE-STORE GROCERY SYSTEMS



TRANSCRITICAL CO₂ REFRIGERATION
SYSTEMS IN 13 STORES

STOUFFVILLE, ON, NOV 2018 "NEAR
NET-ZERO ENERGY SUPERMARKET"

40,000FT² (3,716M²)

35% LESS ENERGY THAN THE AVERAGE
PRODUCES 65% OF ITS OWN ENERGY

247 KW SOLAR PANELS ON ROOF,
FACADE, 39KW ON CARPORT

100KW LITHIUM-ION STORAGE BATTERY

CUT CO₂ EMISSIONS BY 1,500-2,000
METRIC TONS PER YEAR



LONGO'S STOUFFVILLE: CO₂ & HEAT RECOVERY

SOLAR PV & BATTERY

SOBEY'S

63 STORES USING A CO2 TRANSCRITICAL SYSTEM, AND 15-20 STORES OPENING EVERY YEAR WITH CO2.

NORTH AMERICAN LEADERS WITH HEAT RECOVERY, TRANSCRITICAL IN EARLY 2000s

COST PREMIUM DISAPPEARED BUT SAVINGS & REGULATORY CERTAINTY REMAINED.

TWO CANADIAN MANUF WERE ALSO NORTH AMERICAN LEADERS, CARNOT AND LMP INC.



LOBLAWS

TESTED CO₂ & TRANSCRITICAL IN 2013 AT
MAPLE LEAF GARDENS STORE - COMMITTED
TO CO₂ AT THAT TIME BUT THE PROGRAM
STALLED

IN 2019 ANNOUNCED \$48 MILLION TO
CONVERT ALL 370 STORES, CUT 25% OF
LOBLAW'S TOTAL EMISSIONS

INCLUDES \$12 MILLION FROM FEDERAL
GOVERNMENT



WHOLE-STORE GROCERY SYSTEMS

"I FIND IT IMPOSSIBLE TO BELIEVE THAT THERE WILL BE A LAW ANYWHERE ALLOWING REFRIGERANTS WITH RATINGS OF MORE THAN 150 GLOBAL WARMING POTENTIAL (GWP) WITHIN A SHORT TIME....CO2 IS NON-TOXIC, NOT FLAMMABLE, NATURALLY OCCURRING, NO OZONE DEPLETION...COSTS ABOUT A DOLLAR A POUND. SYNTHETICS ARE \$40 PER POUND. THERE ARE NOW ABOUT 30,000 TRANSCRITICAL CO2 SYSTEMS AROUND THE WORLD."

-DAVE MALINAUSKAS, PRESIDENT CIMCO REFRIGERATION, TORONTO.



**GLOBAL NATURAL REFRIGERANTS CONSULTANT SHECCO
SAYS CO2 TRANSCRITICAL SYSTEMS IN GROCERY STORES:**

- ALLOW BETTER TEMPERATURE CONTROL
- COST 10% LESS TO INSTALL
- USE 15% LESS ENERGY
- REDUCE BUILDING HEATING COSTS BY 75% (HEAT RECOVERY)
- REDUCE MAINTENANCE COSTS BY UP TO 50%



REFRIGERATED FOOD WAREHOUSES



C02/AMMONIA HYBRID SYSTEMS

MUCH LOWER AMMONIA CHARGE

- METRO DISTRIBUTION CENTRE, MISSISSAUGA, ONTARIO
- CANADA WIDE FRUIT & VEGETABLE, NEAR MONTREAL
- FLANAGAN FOODSERVICE IN WHITBY, ONTARIO

“IT IS A LOW CHARGE AMMONIA SYSTEM WITH A HEAT EXCHANGER AND C02 IN THE SECONDARY LOOP, CIRCULATED AROUND THE PLANT.

PHASE ONE (AT CANADA WIDE) WAS 280 TONS WITH ONE TWO-KILOWATT PUMP. “BEFORE THAT THIS COMPANY WAS SPENDING ABOUT \$10,000 EACH YEAR ON LEAKING REFRIGERANT, FAILING COMPRESSORS, CONDENSERS, AND EVAPORATORS. NOT NOW...

STAINLESS STEEL, FEWER LEAKS, SMALLER PIPES, SIMPLER INSULATION, LESS EQUIPMENT.” **-BENOIT RODIER, CIMCO**



CO2/AMMONIA HYBRID SYSTEMS

ICEWATER SEAFOOD, ST. JOHN'S, NEWFOUNDLAND

“AT ICEWATER WE WERE USING 160,000 LITRES OF OIL FOR HEAT EACH YEAR. WE DECIDED TO ADD HEAT RECOVERY AND USE THAT INSTEAD OF PAYING FOR OIL.” -**CEO ALBERTO WAREHAM.**

- INVESTMENT ABOUT \$400,000
- GOVERNMENT PGM PAID ABOUT 50%
- 70,000 SQ FT
- GREENHOUSE GAS REDUCTION ABOUT 355 TONS
- USING A LARGE VOLUME OF HOT WATER IN OPERATIONS
- HEAT RECOVERY SYSTEM INCREASES PRESSURE

“NOW THEY HAVE PLENTY OF FAR LESS EXPENSIVE HOT WATER AT 158°F WITHOUT FOSSIL FUELS.” -**COLIN JAMES MAYEKAWA**

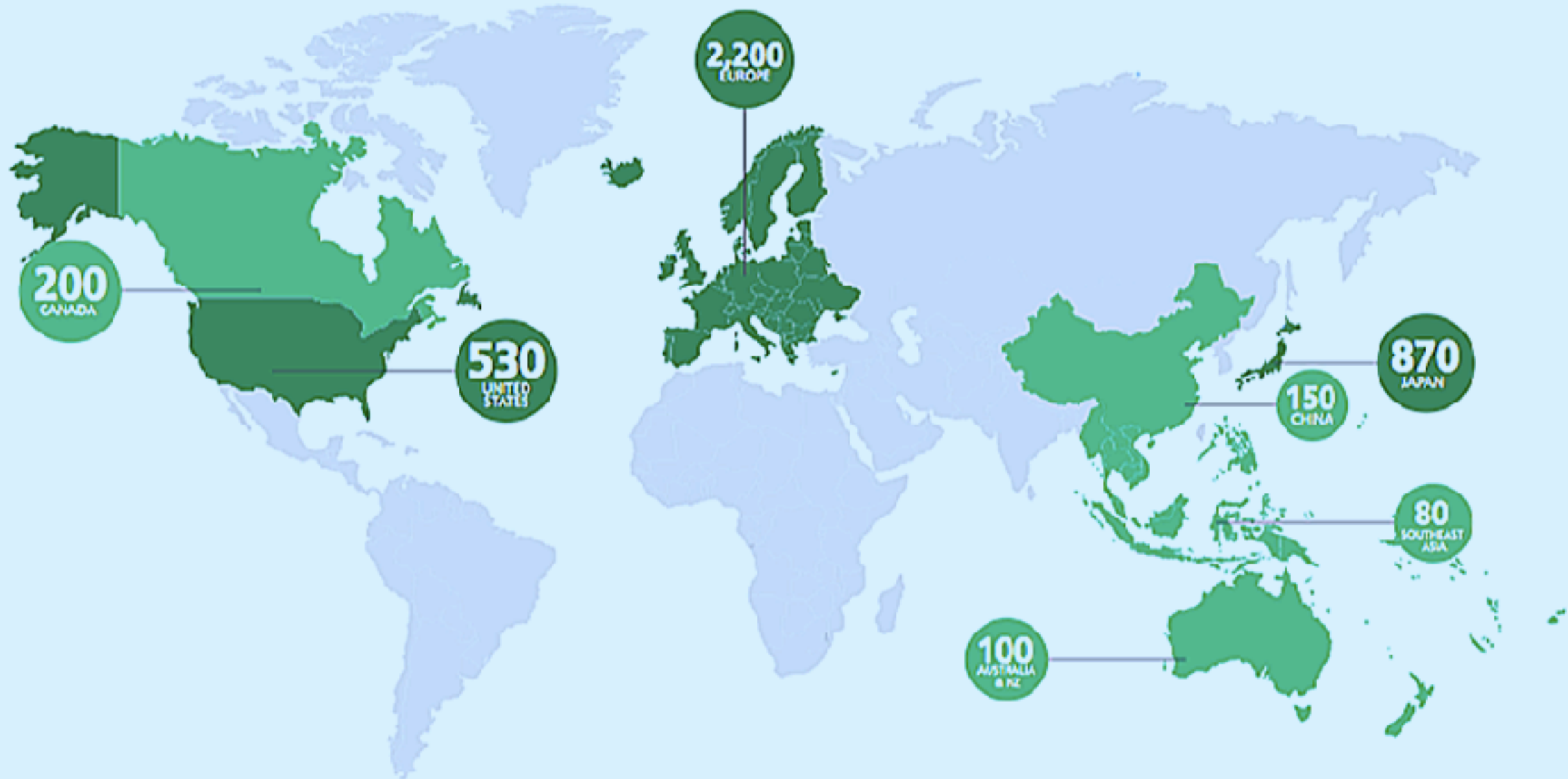


MAYEKAWA IS A 100 YEAR OLD JAPANESE COMPANY THAT IMPORTS EQUIPMENT INTO NORTH AMERICA AND WORKS PRIMARILY WITH NATURAL REFRIGERANTS. IT IS ALSO CREATING INNOVATIVE NEW REFRIGERATION SYSTEMS THAT USE NOTHING BUT AIR OR WATER AS A REFRIGERANT.



CO₂/AMMONIA HYBRID SYSTEMS

LOW-CHARGE AMMONIA INSTALLATIONS AROUND THE WORLD, 2019



AMMONIA21

These figures are based on the 2019 survey of leading manufacturers of low-charge ammonia technology. While reasonable efforts have been made to portray an accurate picture of the market, these figures are not exhaustive and shall serve as an indication of the market for low-charge ammonia.

WALMART NEAR CALGARY

WALMART REFRIGERATED DISTRIBUTION WAREHOUSE BALZAC, ALBERTA

- 400,500 SQUARE FEET, SERVES 104 STORES IN WESTERN CANADA
- 60% MORE ENERGY-EFFICIENT THAN TRADITIONAL CENTRES
- SAVES ABOUT ONE MILLION DOLLARS ON ENERGY EACH YEAR
- AMMONIA SYSTEM 33% MORE EFFICIENT, WILL SAVE \$2 MILLION OVER 5 YEARS
- TWO 30-KILOWATT WIND TURBINES WILL GENERATE ABOUT 100,000 KW/H PER YEAR EACH
- LED LIGHTS SAVE 69% OR \$645,000 OVER 20 YEARS
- SOLAR THERMAL FOR DOMESTIC HOT WATER



ANGELIC BAKE HOUSE



WISCONSIN ARTISAN BAKERY
BUSINESS TOOK OFF,
COPING WITH RAPID GROWTH



NEW CO₂ SYSTEM WITH PREMIUM
COST RECOVERED WITHIN 3 YEARS DUE TO SAVINGS
ON REFRIGERANT, OPERATIONS, ENERGY,
MAINTENANCE, ETC. PLEASE ASK FOR CASE STUDY
WITH FULL TECHNICAL DESCRIPTION.

NATURAL REFRIGERANT CO₂ WITH GWP OF **1.0** IS REPLACING OBSOLETE REFRIGERANTS
R507 (**3300** GWP) R404 (**3300** GWP) & R134 (**1300** GWP).

HILLPHOENIX HAS TRANSCRITICAL ADVANSOR CO₂ SYSTEMS IN HUNDREDS OF
GROCERY STORES ACROSS USA INCLUDING NUMEROUS WALMART INSTALLS,
PLUS ABOUT 35 MANUFACTURING, WAREHOUSE & OTHER BUILDINGS



OSCAR MAYER

HILL PHOENIX ALSO INSTALLED
A CO₂ SYSTEM WITH HEAT ENERGY
RECOVERY AT THE KRAFT / OSCAR MAYER
OHIO PLANT, THE WORLD'S LARGEST
BOLOGNA PLANT AT THE TIME



CONVENTIONAL AMMONIA SYSTEMS REJECT TO EVAPORATIVE CONDENSERS ON ROOFS
WHICH CONSUME A GREAT DEAL OF HOT WATER.

THE OSCAR MAYER CO₂ HEAT PUMP SYSTEM TOOK REJECTED HEAT FROM THE AMMONIA
SYSTEM & REVERSED THE PROCESS FOR HEAT RECOVERY THAT WAS USED TO
CREATE HOT WATER THAT WAS PREVIOUSLY HEATED BY BOILERS,
SAVING LARGE AMOUNTS OF HOT WATER AND GAS.
PLEASE ASK FOR INTRO TO HILLPHOENIX PERSONNEL
WHO WORK ON THESE PROJECTS.

Hillphoenix
an IBM company

Walmart

SUMMER GARDEN FOOD, OHIO



INTEGRATED PROCESS COOLING & HVAC SYSTEMS, ADDED HEAT RECOVERY & INSULATION, EVAPORATIVE-FREE COOLER - FAR LESS ELECTRICITY

RECAPTURED 300 - 500 BTUS PER HOUR WASTE HEAT FROM THE PASTEURIZATION AND COOLING PROCESS & SENT IT BACK INTO THE PLANT.

CHANGED PASTEURIZER COOLER SPRAY NOZZLE, REDUCED PRESSURE BY ONE-THIRD



GLYCOL IS COOLED USING AIR FROM OUTSIDE THE PLANT, AND PIPING FROM THE PASTEURIZER COOLER TABLE SENDS WARM WATER FROM THE TABLE FOR POST PROCESSING.



SAVINGS: \$12,000 ANNUALLY IN PUMPING, \$30,000 IN COOLING, PER-UNIT WATER CONSUMPTION FOR COOLING CUT ABOUT 75%.

TECH ADVISER DARRELL WALLACE WORKED WITH ARROWHEAD MECHANICAL (INDIANA)

"I DON'T BELIEVE WE'D BE DOING BUSINESS WITH COSTCO WITHOUT THIS TYPE OF FACILITY,"

-JOHN ANGELILLI, CHIEF OPERATING OFFICER, SUMMER GARDEN, OHIO



NHL HOCKEY RINKS

HEAT RECOVERY FROM ICE MAKING

- AS OF DEC 2018 ST LOUIS BLUES, SAN JOSE SHARKS, ANAHEIM DUCKS, ARIZONA COYOTES, RYERSON RAMS AT MAPLE LEAF GARDENS (MATTAMY CENTRE) & MAPLE LEAF GARDENS LOBLAWS ALL USED AMMONIA SYSTEMS WITH HEAT RECOVERY. MORE NHL TEAMS WERE EXPECTED TO FOLLOW SUIT.
- ARENA GURU SCOTT WARD, STEVENS ENGINEERING HAS WORKED ON DESIGNS FOR HEAT RECLAMATION SYSTEMS FOR 225+ ARENAS



ST. LOUIS BLUES



ANAHEIM DUCKS



MAPLE LEAF GARDENS (MATTAMY CENTRE)



SAN JOSE SHARKS.



ARIZONA COYOTES

BENTLEY ARENA, NEAR BOSTON

LEED PLATINUM BENTLEY ARENA IN WALTHAM, MASSACHUSETTS, 2018

- 160-TON INDIRECT FLOODED SYSTEM WITH 50 TONS OF HEAT RECOVERY, OR ABOUT 30%.
- RECOVERED HEAT USED FOR PERMAFROST PREVENTION BELOW THE SUB FLOOR. PERMA-FROST PREVENTION IS REQUIRED FOR ARENAS OPERATING MORE THAN 6 MONTHS TO PROTECT BUILDING FOUNDATION.
- RECOVERED HEAT ALSO PRE-WARMS DOMESTIC HOT WATER IN THE BUILDING TO BETWEEN 110°F AND 130°F.
- ALSO USED AT 85°F TO MELT RINK SURFACE SHAVINGS IN AN ICE PIT. ZAMBONI DOES NOT DEPOSIT ICE & SNOW OUTSIDE, ELIMINATING MESS & ENERGY LOSS THROUGH BIG OUTSIDE DOORS. SAVES MORE ENERGY, WATER, SUPPORTS HUMIDITY CONTROL.
- TOTAL ENERGY REDUCTION IS 60%.



UPPER CANADA COLLEGE

WILLIAM P. WILDER ARENA & SPORTSPLEX

- ECO CHILL 150A HEAT RECOVERY PACKAGE USING R-717 AMMONIA WAS INSTALLED IN 2014.
- CONNECTED TO A THERMAL EQUALIZED GLYCOL SYSTEM, USES WASTE HEAT FOR SUB FLOOR WARMING BELOW TWO ICE SHEETS,.
- USED FOR ICE AND SNOW MELT, AND SERVICE WATER HEAT FOR THE ZAMBONI.
- COMBINED WITH A GROUND SOURCE GEOTHERMAL FIELD BENEATH A NEARBY FOOTBALL/SOCCER FIELD.
- THE COMBO ALSO SUPPLIED DOMESTIC HOT WATER AND SOME RADIANT HEAT FOR DRESSING ROOMS, PUBLIC WASHROOMS, ARENA BENCH SEATING, AND VISITORS' GALLERIES.
- LEED CERTIFIED.



BERWICK, NOVA SCOTIA

KINGS MUTUAL CENTURY CENTRE ("APPLE DOME")

CASCADING DOUBLE LOOP AMMONIA SYSTEM, SABROE HEAT PUMP FOR HEAT RECOVERY FROM THE ICE PLANT, ADVANCED CONTROLS, RECIPROCATING COMPRESSORS.

DID NOT DELIVER PROMISED SAVINGS, SO RECOMMISSIONED:

- EQUALIZED PIPING
- SET-UP CONTROLS PROPERLY
- HEATING LOOP DESIGNED FOR 150°F, REDUCED TO 120°F CUT CONDENSING PRESSURE FROM 500 TO 300 PSI
- SAVED ENERGY, REDUCED WEAR AND TEAR ON THE HEAT PUMP COMPRESSOR. OPERATING COSTS WENT FROM \$110,000 DOWN TO LESS THAN \$75,000.
- BEGAN RUNNING ONE COMPRESSOR & ONE BRINE PUMP AT A TIME, SHUT SYSTEM AT NIGHT, INSTALLED VARIABLE FREQUENCY DRIVES, CONTROLLED AMPERAGE DRAW AND REDUCED BRINE FLOW AT COLDER TEMPERATURES. THIS DECREASED HEAT GAINS IN THE BRINE CAUSED BY FRICTION.



FERNIE, BRITISH COLUMBIA

AMMONIA CAN KILL YOU - THREE TECHNICIANS DIED AT FERNIE MEMORIAL ARENA IN 2017

IN 2010 A 31 YEAR OLD CHILLER WAS DEEMED TO BE AT THE END OF USEFUL LIFE (NORMALLY 20-25 YEARS). REPLACEMENT SCHEDULED FOR 2013, THEN 2014, THEN DROPPED.



“YOU CAN SMELL IT, SO IT WILL SCARE YOU AWAY. IT HAS TO BE A CLASS T MACHINERY ROOM, WITH SENSORS AND ALARMS, AND AN AUTO EXHAUST FAN AS REQUIRED BY THE B-52 CODE.”

“THE SAFETY SYSTEMS ARE BUILT INTO THE CODE, BUT THE PLACEMENT OF DEVICES AND ROOM LAYOUT MATTERS TOO. DESIGN IT CORRECTLY IN THE FIRST PLACE. THE EGRESS DOORS SHOULD BE PROPERLY LOCATED, THE SAFETY DEVICES TOO, STROBE ALARMS, PRESSURE RELEASE DEVICES SHOULD VENT INTO A WATER TANK, TWO STAGE VENTILATION FANS, EMERGENCY STOP BUTTONS AND MANUAL SWITCHES OUTSIDE THE ROOM. TECHS NEED TO BE TRAINED TO USE THE SYSTEMS THAT ARE IN PLACE.”

“ALL REFRIGERANT IS DANGEROUS. EVEN 507 COULD SUCK THE OXYGEN OUT OF YOU. AMMONIA GETS MORE BAD PRESS BECAUSE IT’S MORE TOXIC, BUT WE’VE BEEN USING IT FAIRLY SUCCESSFULLY SINCE THE 1800S.”

REFRIGERATION TRAINING & STANDARDS

REFRIGERATION TRAINING

[HTTPS://WWW.ONTARIO.CA/PAGE/REFRIGERATION-AND-AIR-CONDITIONING-SYSTEMS-MECHANIC](https://www.ontario.ca/page/refrigeration-and-air-conditioning-systems-mechanic)

[HTTPS://WWW.MOHAWKCOLLEGE.CA/PROGRAMS/SKILLED-TRADES/REFRIGERATION-AND-AIR-CONDITIONING-SYSTEMS-MECHANIC-313A](https://www.mohawkcollege.ca/programs/skilled-trades/refrigeration-and-air-conditioning-systems-mechanic-313a)

[HTTPS://WWW.ONTARIO.CA/PAGE/CERTIFICATE-HANDLE-REFRIGERANTS](https://www.ontario.ca/page/certificate-handle-refrigerants)

INSPECTION TIPS

[HTTP://INDREF.CA/AMMONIA-REFRIGERATION-GUIDELINES-SCHEDULED-INSPECTIONS/](http://indref.ca/ammonia-refrigeration-guidelines-scheduled-inspections/)

HFC PHASEDOWN

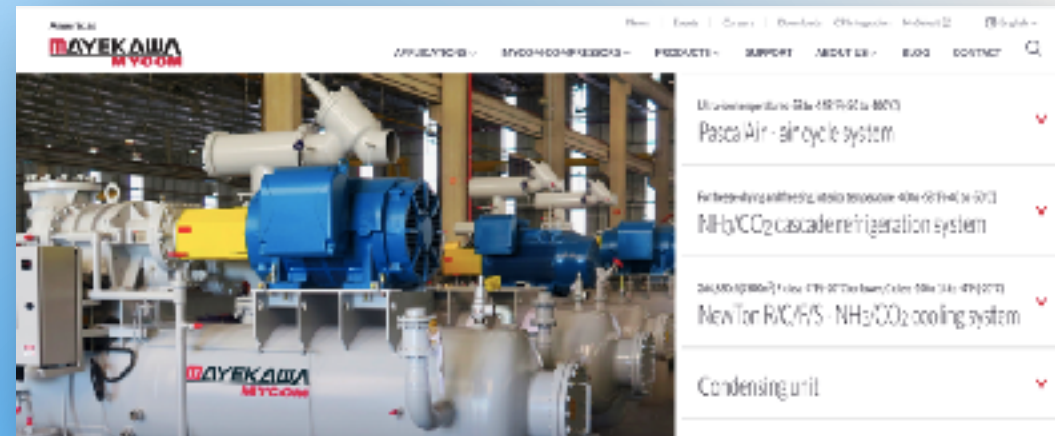
[HTTPS://WWW.CANADA.CA/EN/ENVIRONMENT-CLIMATE-CHANGE/SERVICES/CANADIAN-ENVIRONMENTAL-PROTECTION-ACT-REGISTRY/OZONE-REGULATIONS-AMENDMENTS-QUESTIONS.HTML](https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/ozone-regulations-amendments-questions.html)

[HTTPS://WWW.EPA.GOV/SNAP](https://www.epa.gov/snap)

FOR REFERENCE

TRANSCRITICAL CO₂ REFRIGERATION SYSTEMS

KEY PLAYERS RIGHT NOW: CARRIER COMMERCIAL REFRIGERATION (US), GREEN & COOL WORLD REFRIGERATION AB (SWEDEN), HILLPHOENIX, INC. (US), ADVANSOR (DENMARK), DANFOSS (DENMARK), BITZER (GERMANY), CARNOT REFRIGERATION (CANADA), SCM FRIGO S.P.A. (ITALY), EMERSON CLIMATE TECHNOLOGIES (US), BALTIMORE AIRCOIL COMPANY (US), HENRY TECHNOLOGIES, INC. (US), SYSTEMES LMP, INC. (CANADA), MAYEKAWA MFG. CO., LTD. (JAPAN), AND PANASONIC (JAPAN).



GUIDELINES FOR ENGINEERS & PROJECT MANAGERS:





QUESTIONS?

Ultra-Cool Heat Recovery & Natural Refrigerants

Fri Nov 20, 2020 | 11:00 AM - 12:00 PM ET



**Clean Air
Partnership**

CLIMATE SOLUTIONS WEBINAR SERIES



THANK YOU

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