Aztech Geothermal

Beneficial *Refrigeration*

Quantifying the Net Impacts of Heat Pumps Potential to Reduce CO2 vs. the High GWP of Refrigerants

Example: 4 ton GSHP displacing 1,000 gal of #2 Heating Oil/yr

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(eGRID2016 Upstate NY)

Beneficial Refrigeration / First Year / Upstate NY

Net Avoided CO2 GWP of 1,000 Gallons of #2 Heating Oil Replaced by 4 Ton GSHP

CO_2

Total R410A GWP of 100% Loss/Release of a 2.63kg Charge for 4 Ton GSHP

R410A

After one year, you still have not displaced enough on-site oil combustion to overcome the CO2e of losing the whole charge.

0.8 : 1 Ratio

Assumptions:

CO2 = 1 GWP

R410A = 4,340 GWP (20 year basis)

Annual Assumptions:

1,000 gallons of #2 Oil Avoided/yr

10.15 metric tons CO2 Avoided/yr

8,100 kWh/yr to run 4 ton GSHP

1.13 metric tons/yr power plants

(eGRID2016 Upstate NY)

Comparison of GWP *after 1 Year*

Example: 4 ton GSHP displacing 1,000 gal of #2 Heating Oil/yr

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Beneficial Refrigeration / After 25 Years / Upstate NY

After 25 years, you have **displaced 18.7 times more CO2** by avoided oil combustion compared to the CO2e of losing the whole charge.

Net Avoided CO2 GWP of 1,000 gal/year for **25 years of #2 Heating Oil** Replaced by 4 Ton GSHP

Total R410A GWP of 100% Loss/Release of a 2.63kg Charge for 4 Ton GSHP

R410A

Assumptions:

CO2 = 1 GWP

R410A = 4,340 GWP (20 year basis)

Annual Assumptions:

1,000 gallons of #2 Oil Avoided/yr

10.15 metric tons CO2 Avoided/yr

8,100 kWh/yr to run 4 ton GSHP

1.13 metric tons/yr power plants

(eGRID2016 Upstate NY)

18.7 : 1 Ratio

Comparison of GWP *after 25 Years*

Example: 4 ton GSHP displacing 1,000 gal of #2 Heating Oil/yr

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Beneficial Refrigeration / First Year / Westchester/NYC

Net Avoided CO2 GWP of 1,000 Gallons of #2 Heating Oil Replaced by 4 Ton GSHP

CO_2

Total R410A GWP of 100% Loss/Release of a 2.63kg Charge for 4 Ton GSHP

R410A

Similar to Upstate but a bit worse since the electric grid has a larger carbon contribution to the heat pump electricity.

Assumptions:

CO2 = 1 GWP

R410A = 4,340 GWP (20 year basis)

Annual Assumptions:

1,000 gallons of #2 Oil Avoided

10.15 metric tons CO2 Avoided

8,100 kWh to run 4 ton GSHP

2.44 metric tons from power plants

(eGRID2016 Westchester/NYC)

0.6 : 1 Ratio

Comparison of GWP *after 1 Year*

Example: 4 ton GSHP displacing 1,000 gal of #2 Heating Oil/yr

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Beneficial Refrigeration / 25 Years / Westchester/NYC

Even with the higher carbon contribution from the grid downstate after 25 years, you have **displaced 15.9 times more CO2** then the damage of losing all the refrigerant

Net Avoided CO2 GWP of 1,000 gal/year for **25 years of #2 Heating Oil** Replaced by 4 Ton GSHP

Total R410A GWP of 100% Loss/Release of a 2.63kg Charge for 4 Ton GSHP

R410A

Assumptions:

CO2 = 1 GWP

R410A = 4,340 GWP (20 year basis)

Annual Assumptions:

1,000 gallons of #2 Oil Avoided

10.15 metric tons CO2 Avoided

8,100 kWh to run 4 ton GSHP

2.44 metric tons from power plants

(eGRID2016 Westchester/NYC)

15.9 : 1 Ratio

Comparison of GWP *after 25 Years*

Example: 4 ton GSHP displacing 1,000 gal of #2 Heating Oil/yr

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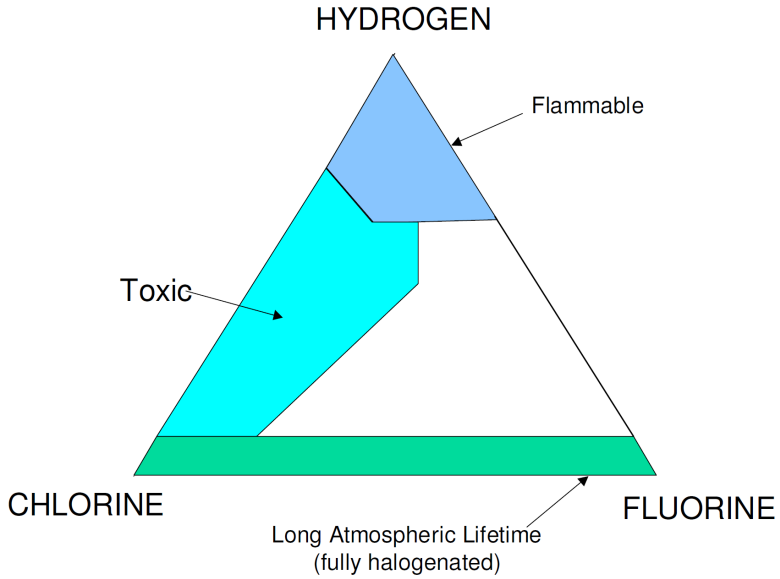
Basics on Refrigerants Used in Heat Pumps

Desirable Refrigerant Properties

- Zero Ozone Depletion Potential (ODP)
- Zero Global Warming Potential (GWP)
- Non-flammable
- Non-Toxicity
- Stable Under Wide Range of Conditions
- Atmospheric Boiling Point between -40F & 32F



Refrigerants and Global Warming Potential

Required 20 Year GWP Timeframe in CLCPA (NYS law)

GWP = Global Warming Potential = Atmospheric Lifetime x Infrared Absorbance

- GWP of Carbon Dioxide = 1
- Refrigerants:
  - R-717 (industry, some commercial)
  - R-744 (hi-temp heat pumps, DHW)
  - R-290 (most typical air conditioners)
  - R-410 (most typical air conditioners)
  - R-32 (lower GWP for AC & HPs)
  - R-134A (car air conditioners)
  - R-404A (grocery store coolers)
- ***All have 0 Ozone Depletion Potential (ODP)***

Refrigerant Name	Type	Gas	100 yr GWP	20 yr GWP
R-717	N/A	Ammonia	0	0
R-744	N/A	CO2	1	1
R-290	HC	Propane	<3	<3
R-32	HFC	HFC-32	675	2330
R-410A	HFC	Puron	2,088	4340
R-134a	HFC	HFC-134a	1,430	3790
R404A	HFC	HP-62	3,900	6010

Refrigerant Management – The 5 R's

1. Record Keeping
2. Repair Leaks
3. Reclaim & Recover
4. Replace Old Equipment
5. Retrofit to Lower ODP & GWP Refrigerants