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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Net Avoided CO2 GWP of 1,000 Gallons 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

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

Comparison of GWP after 1 Year

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

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)
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

18.7 : 1 Ratio

Comparison of GWP after 25 Years

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

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

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

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

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
Even with the higher carbon contribution from the grid downstate after 25 years, you have **displaced 15.9 times more CO2** than 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

**15.9 : 1 Ratio**

Comparison of GWP after 25 Years

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

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

**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)
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

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)

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<tr>
<th>Refrigerant Name</th>
<th>Type</th>
<th>Gas</th>
<th>100 yr GWP</th>
<th>20 yr GWP</th>
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Required 20 Year GWP Timeframe in CLCPA (NYS law)
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