

ET Summit 2021

Presented by



HVAC Refrigerants Update

The Next Transition Has Begun

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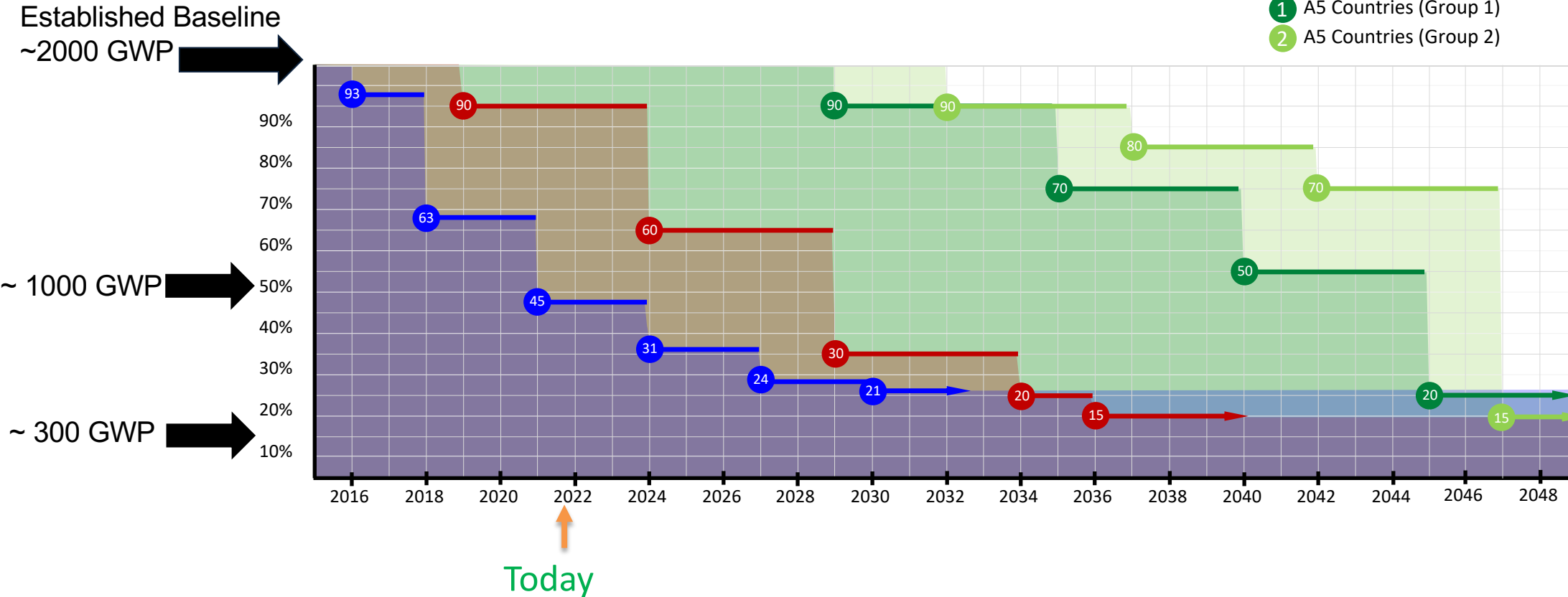


2016 Montreal Protocol HFC Amendment Agreement

Kigali Amendment - Global Transitions Based on GWP

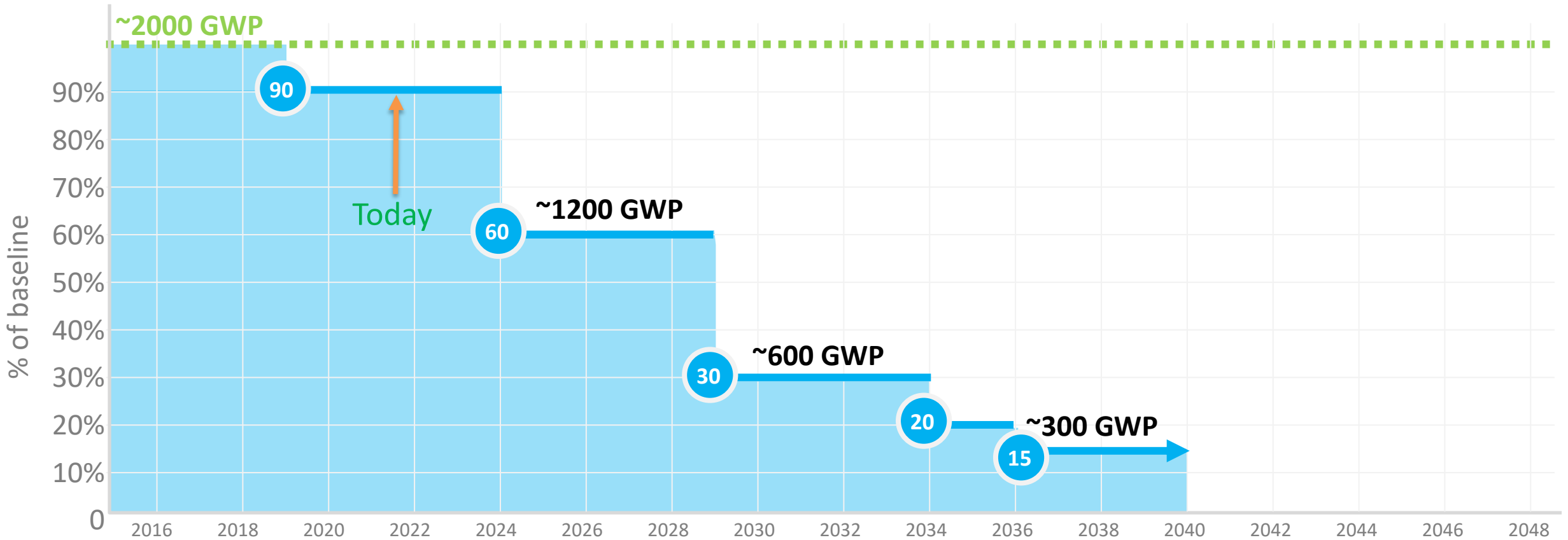


- European Union
- A2 Countries (Developed)
- 1 A5 Countries (Group 1)
- 2 A5 Countries (Group 2)



More Complex Than ODP Phase Out (Banned Chemicals)
This is a Phase Down (All Refrigerants Available for Use)

Closer Look - USA – GWP Cap and Phase Down Details



Kigali Phase-Down of HFCs starting in 2019 for Developed Nations
 USA (AIM Act) – Starting ↓10% 2022 then ↓40% by 2024 (Rule Expected 2022)

How and When on United States HFC Phasedown Timing



- On April 30 in accordance with the AIM legislation, the USEPA issued a proposed rule to reduce HFC production and consumption

<https://www.epa.gov/newsreleases/epa-moves-forward-phase-down-climate-damaging-hydrofluorocarbons>

- On Oct 1 & Oct 5 - HFC allocation final rule issued in accordance with AIM
 - 10% reduction for 2022 and 2023 (expect 40% reduction rule next year)
 - HFC baseline set using 3 highest production years between 2011-2019
 - Ban of non-refillable cylinders by 2027
 - Required tracking of refrigerants and use (QR codes)
- On Oct 7 – Grants petitions in support of HFC phasedown for rule making
 - AHRI, AHAM, EIA, NRD..etc means EPA granting or partial granting requests made in future rule making

EPA Rules and SNAP Notices

<https://www.epa.gov/climate-hfcs-reduction>

<https://www.epa.gov/snap/snap-regulations#rule23supplemental>

EPA will Release Final HFC Rule Up To 40% Phasedown in 2022

AHRI & AHAM Petition – Air Conditioning, Chillers, Commercial Refrigeration

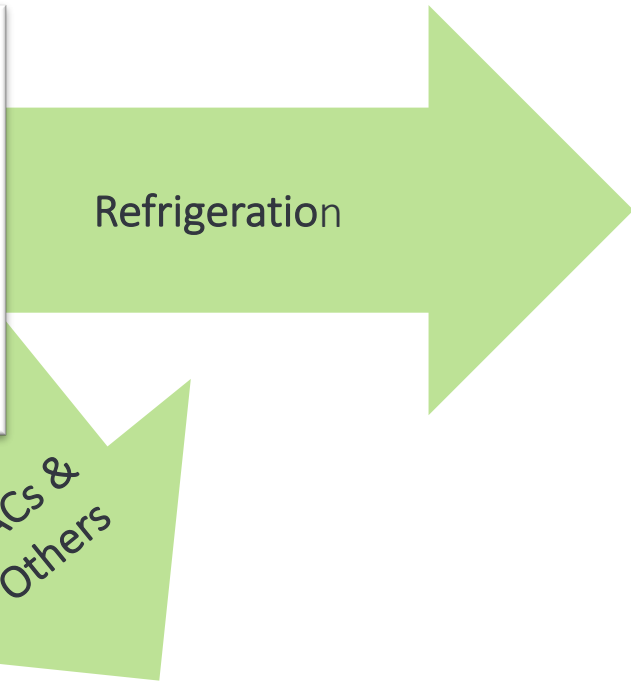


TABLE 1

Product Category (New Equipment ¹)	AR4 GWP Limit	Transition Date
Standalone/Self-contained Refrigeration Systems	SNAP Rules 20/21 Prohibitions	January 1, 2022
Remote Refrigeration Systems (> 50 lbs refrigerant charge)	1500	January 1, 2022
Remote Refrigeration Systems (<= 50 lbs refrigerant charge)	2200	January 1, 2022
Industrial and Processing Refrigeration (w/o chillers)	1500	January 1, 2022
ACIM (> 50 lbs refrigerant charge)	2200	January 1, 2022
Transport Refrigeration	2200	January 1, 2023

Exceptions: ACIM < 50lbs charge, Medical, Scientific and Research Applications

¹ SNAP Rules 20 and 21 <https://www.govinfo.gov/content/pkg/FR-2015-07-20/pdf/2015-17066.pdf> and <https://www.govinfo.gov/content/pkg/FR-2016-12-01/pdf/2016-25167.pdf>

TABLE 2

Chillers ⁵	AR4 GWP Limit	Transition Date
Chillers (designed for chilled fluid leaving temperature > +35° F)	750	January 1, 2024
Chillers (designed for chilled fluid leaving temperature ≤+35° and > -10° F)	1500	January 1, 2024
Chillers (designed for chilled fluid leaving temperature ≤-10° to -50° F)	2200	January 1, 2024
Chillers (< 20lbs charge) (designed for chilled fluid leaving temperature <+35° F)	2200	January 1, 2024

Exceptions: Chillers <-50 F, Medical, Scientific and Research Applications

AC Chiller Equipment

Jan 1, 2024

Unitary and VRF Equipment

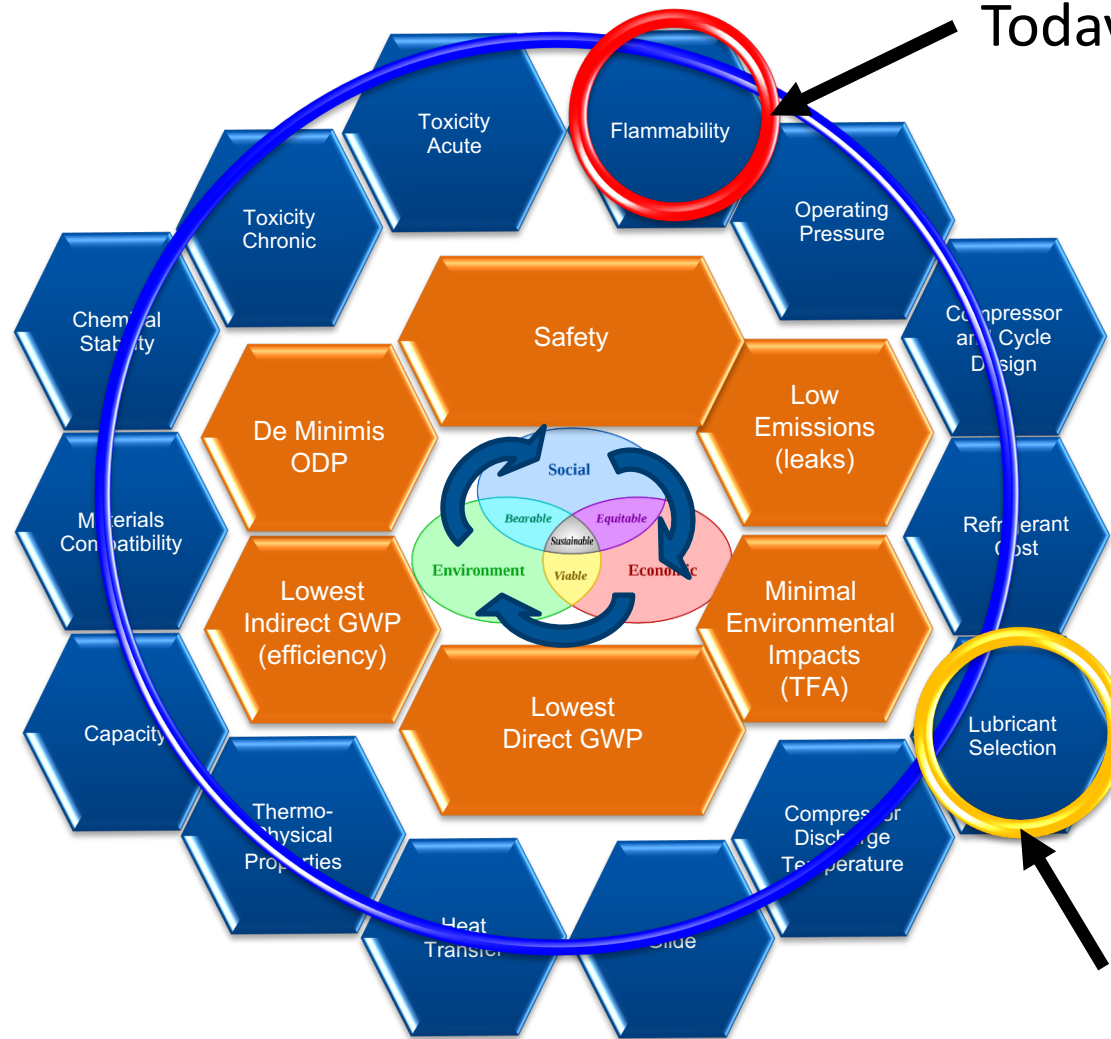
Unitary: Jan 1, 2025
VRF: Jan 1, 2026

Jan 1, 2023 – No Electric Heat
Jan 1, 2024 - Electric Heat
Dehumids - 2 yrs after R-32 SNAP Approved

Refrig -More Complex Based On Available Technology by App

AC - <750 GWP For All Products

Refrigerant Replacement Challenge



Today Primary Challenge

Balancing Key Factors for;

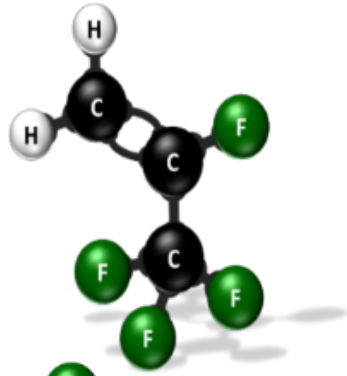
- Direct Refrigerant GWP
- Efficiency (Indirect GWP)
- Safety
- Transition Costs
- Intellectual Property
- Product Sustainability

Last Transition Challenge

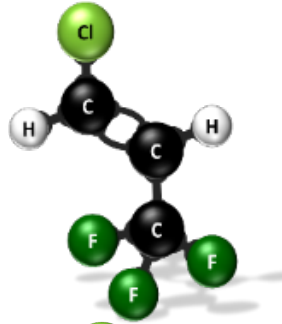
Challenge: Selecting Refrigerants with Best Balance (Sustainability)
 Flammability Greatest Challenge for this Transition – Not in All Cases

Toolbox of <10 GWP Next Generation Refrigerants

R1234yf
A2L GWP <1



R1233zd(E)
A1 GWP 1

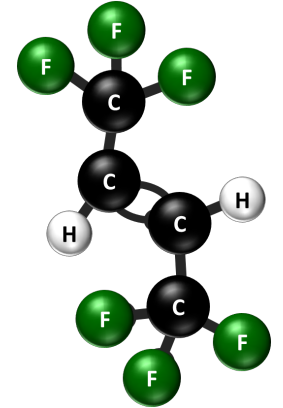


R1130(E)
B2L GWP <1

R1336mzz(Z)
A1 GWP <2

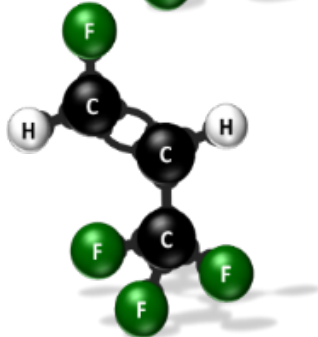
Azeotropic

R514A
B1 GWP <2

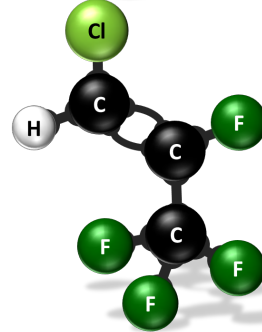


R1336mzz(E)
A1 GWP <6

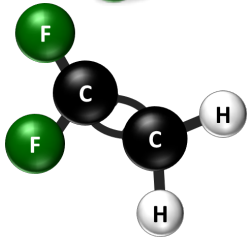
R1234ze(E)
A2L GWP <1



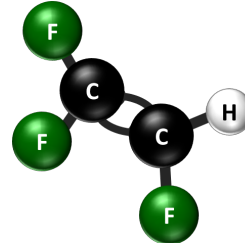
R1224yd(Z)
A1 GWP 1



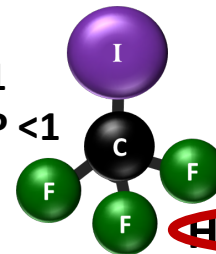
R1132a
A2 GWP <1



R1123
A2L GWP <1



R131I
A1 GWP <1



Along with
Carbon Dioxide (R744) – A1
Ammonia (R717) – B2L

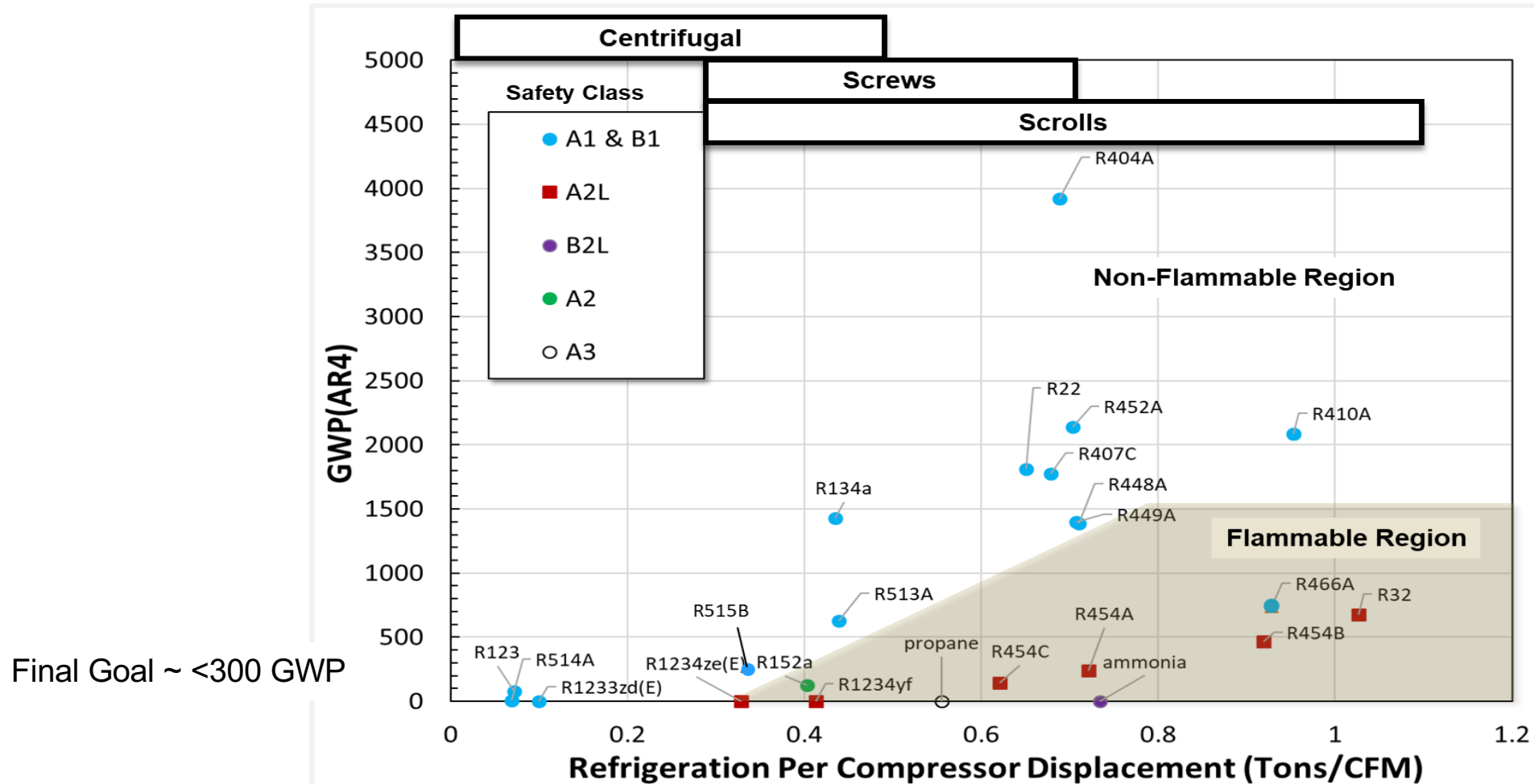
Hydrocarbons (R290, R600, R600a) – A3

6 New Molecules/9 Older Molecules - HFOs, HCFOs, HCOs, IFC, CO2, NH3, HCs

Many of Which are Flammable – Remember Flammables are Flammable

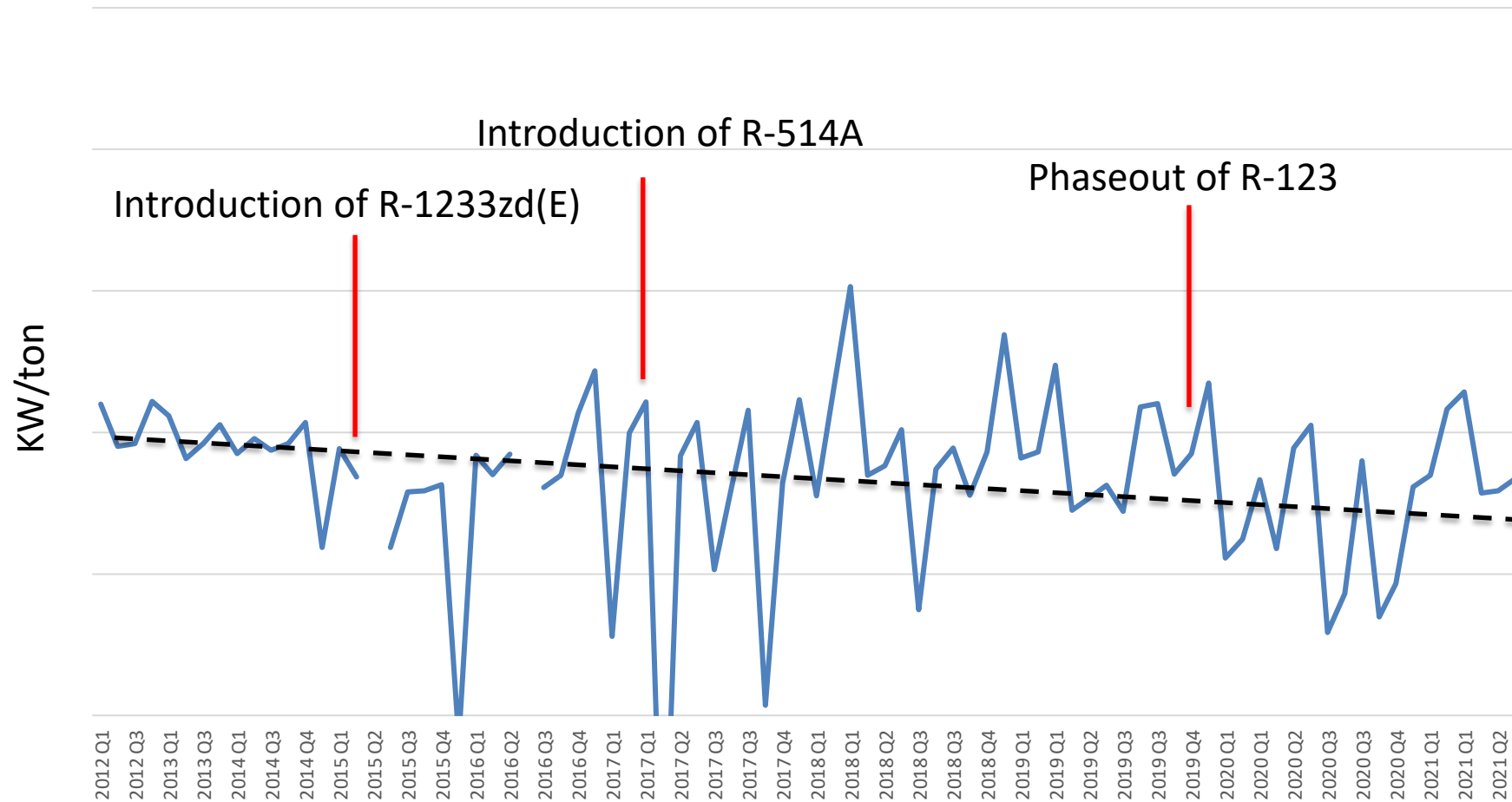
Standards & Building Codes Updates by 2024 to Allow Wide Scale Adoption of Flammables

Closer Look – Viable Lower & Ultra Low GWP Alternatives



Flammable Refrigerants Required For Some Applications
 Interim Refrigerant Adoption Required to Achieve GWP Phasedown Goals

Efficiency Impacts – Large Centrifugal Chillers



No Efficiency Impacts - Possible Gains

What Refrigerant Actions Should I Take Now?

- Low GWP refrigerant innovation is an on-going balance of known science and proven technologies. There are some long term ultra low GWP solutions available today.
- Finding the safest, best balance that enables the LOWEST emissions, the HIGHEST efficiency and the LOWEST life-cycle costs is key.
 - Take a balanced approach during regulatory uncertainty (refrigerant & efficiency)
 - Maintaining existing installed equipment is also key (leak tightness and efficiency) to reduce GHG impacts
- Low GWP alternatives available today, only non-flammable options allow easy adoption
 - Long term solution, e.g. GWPs <10” alternatives, R-514A, R-1233zd(E), are available today (larger applied water-cooled chiller products >200 tons)
 - Lower GWP interim solutions for >100 ton applied R-134a containing products, R-513A, are available today. Long term solutions (<150 GWP) will be flammable and available by 2024 to 2026 (building code updates)
 - Lower GWP interim solutions for Unitary and residential applications (R-410A replacements), R-32 & R-454B, (flammable need building code updates). Interim solutions (750 to 460 GWP), flammable. Innovation required to achieve final 85% reduction goals, expect another transition in 2030’s if lower GWP technology is available.



Understand The Facts... Evaluate Your Options... Plan & Prepare For Tomorrow

Men Continue to Argue...

Nature Acts



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Sunrise over the Mississippi River at my House – Brownsville, Minnesota