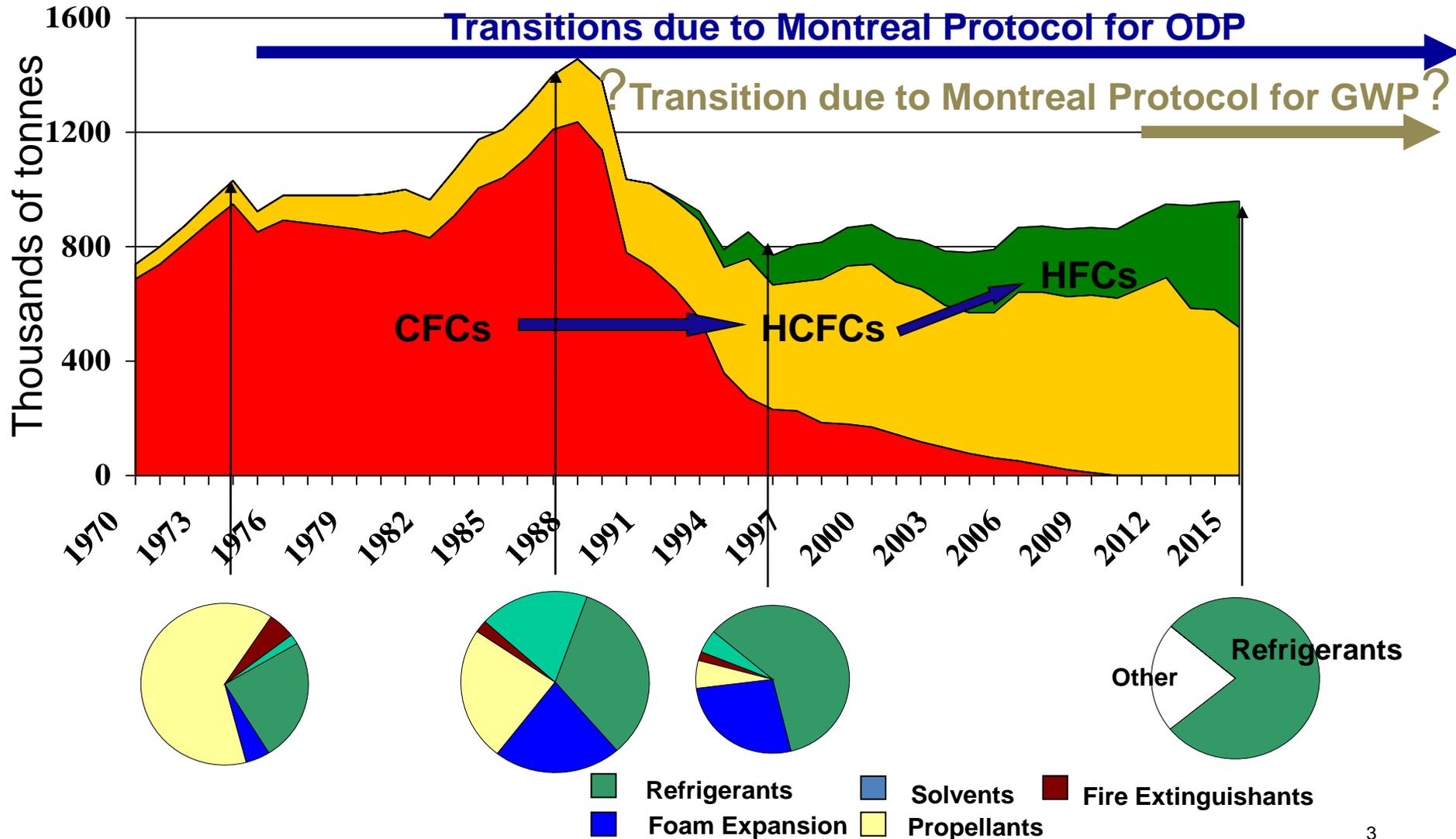


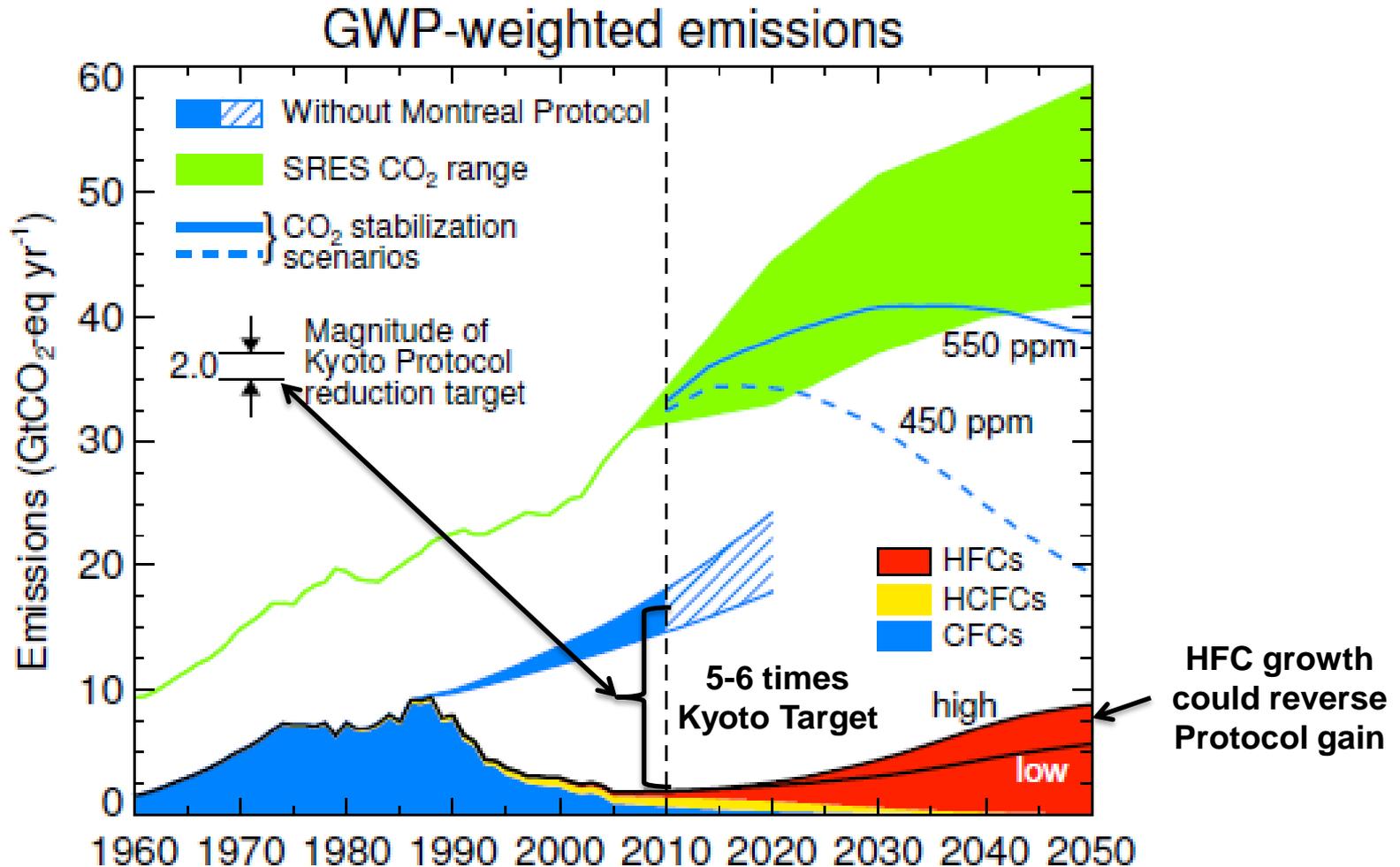


The Montreal Protocol and Hydrofluorocarbons (HFCs)

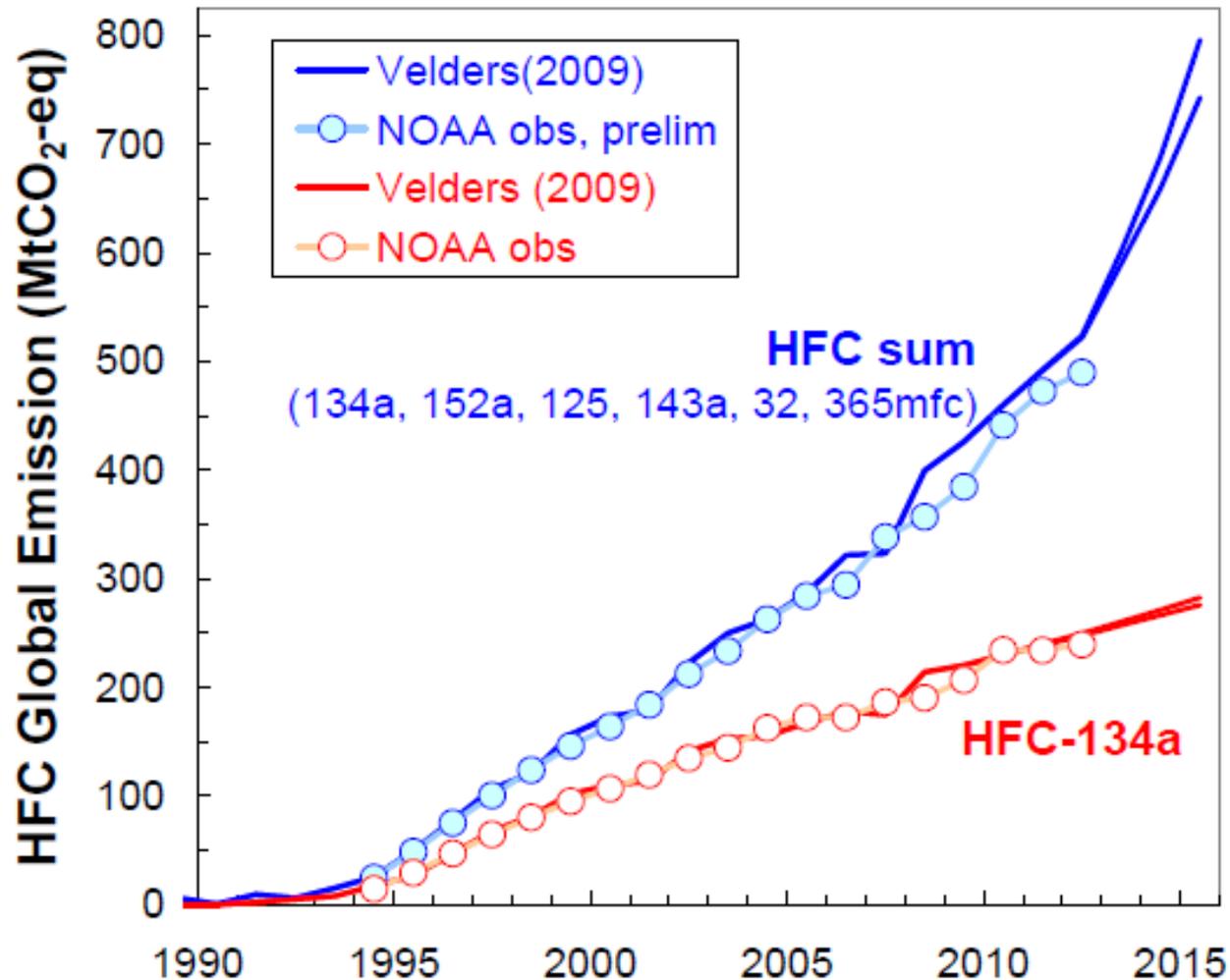
**Mack McFarland, Ph.D.
Global Environmental Manager
DuPont Fluorochemicals**

- **Societal benefits include**
 - Refrigeration to preserve food and medicine
 - Air conditioning to save lives and improve productivity
 - Industrial and process cooling
 - Insulating plastic foams to save energy
 - Medical applications to save lives and improve quality of life
 - Fire extinguishants to save lives
- **Their value proposition**
 - Safety; low toxicity and no or low flammability
 - Desirable physical properties
 - Cost effective
- **However**
 - CFCs and HCFCs both deplete ozone and contribute to climate change
 - HFCs contribute to climate change

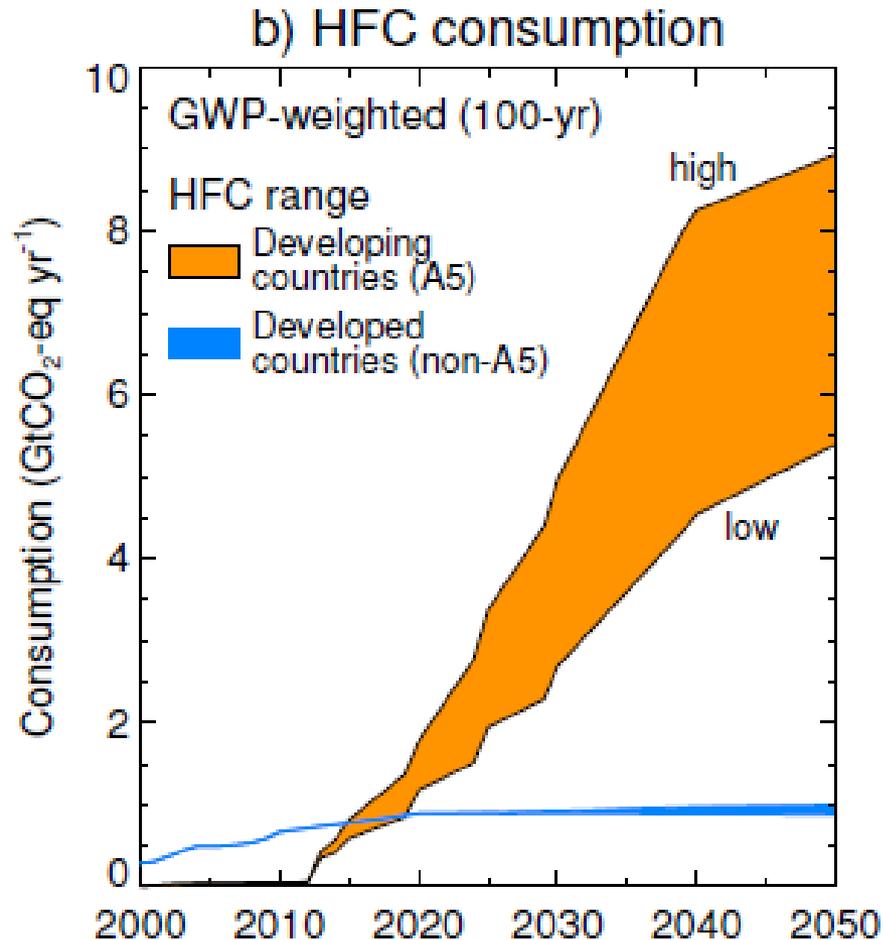




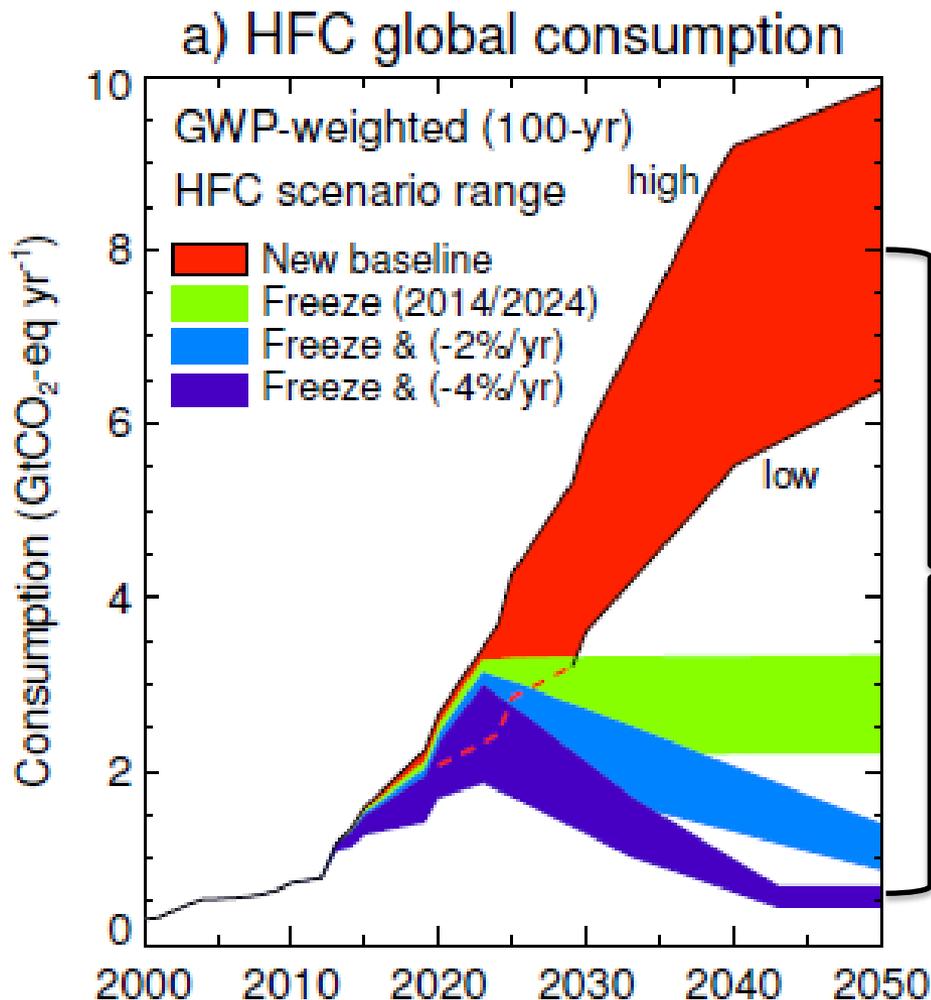
From: Velders, Guus J. M., David W. Fahey, John S. Daniel, Mack McFarland, and Stephen O. Andersen, *The large contribution of projected HFC emissions to future climate forcing*; Proceedings of the National Academy of Sciences, published online July 7, 2009.



Note: NOAA data for HFC-134a are based on the extension of a published record. NOAA data for other HFCs are unpublished and preliminary, provided courtesy of S. Montzka, NOAA.



From: Velders, Guus J. M., David W. Fahey, John S. Daniel, Mack McFarland, and Stephen O. Andersen, *The large contribution of projected HFC emissions to future climate forcing*; Proceedings of the National Academy of Sciences, published online July 7, 2009.



Amendment could reduce cumulative global consumption by over 100 Billion Tonnes CO₂-eq = over 15 times U.S. GHG emissions in 2011

From: Velders, Guus J. M., David W. Fahey, John S. Daniel, Mack McFarland, and Stephen O. Andersen, *The large contribution of projected HFC emissions to future climate forcing*; Proceedings of the National Academy of Sciences, published online July 7, 2009.

Select for Best Balance of Properties for Each Application



Zero-ODP, Low-GWP, Favorable LCCP
Favorable Toxicity
No or Low Flammability

**Safety and
Sustainability**

System Energy
Efficiency
+
Capacity

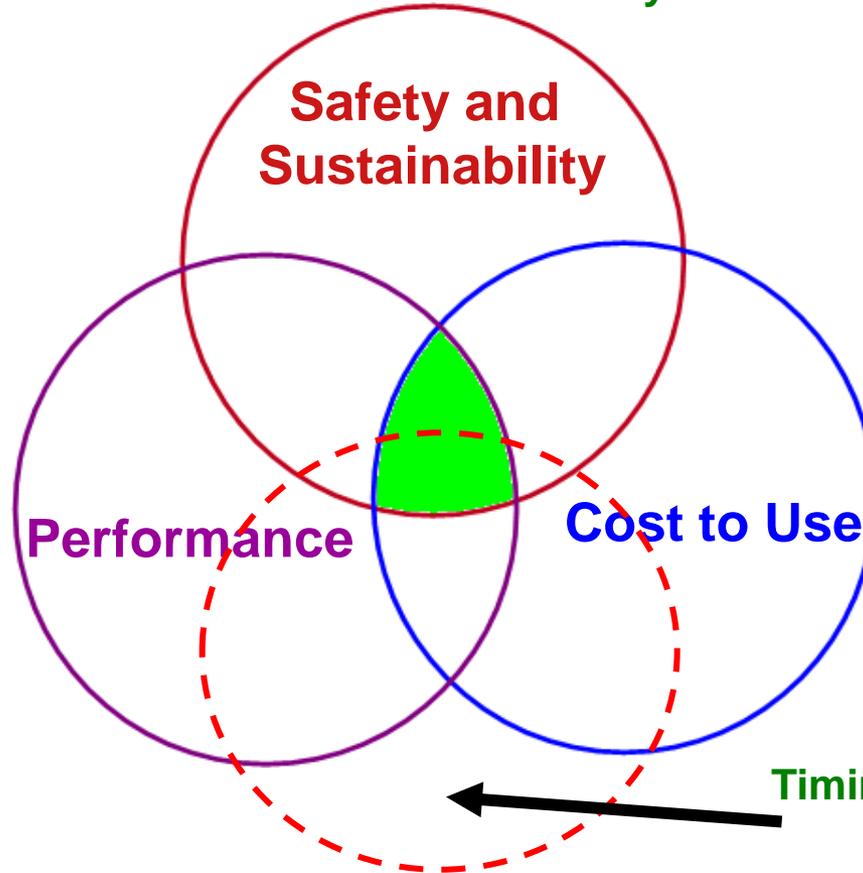
Performance

Cost to Use

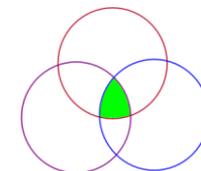
$$\frac{\text{First Cost} + \text{Operating}}{\quad} = \text{Total Cost to Use}^{**}$$

** Impacted by maturity of technology

**Timing of Commercial
Availability**



DuPont™ Opteon® -- The Optimal Balance of Properties for Each Application

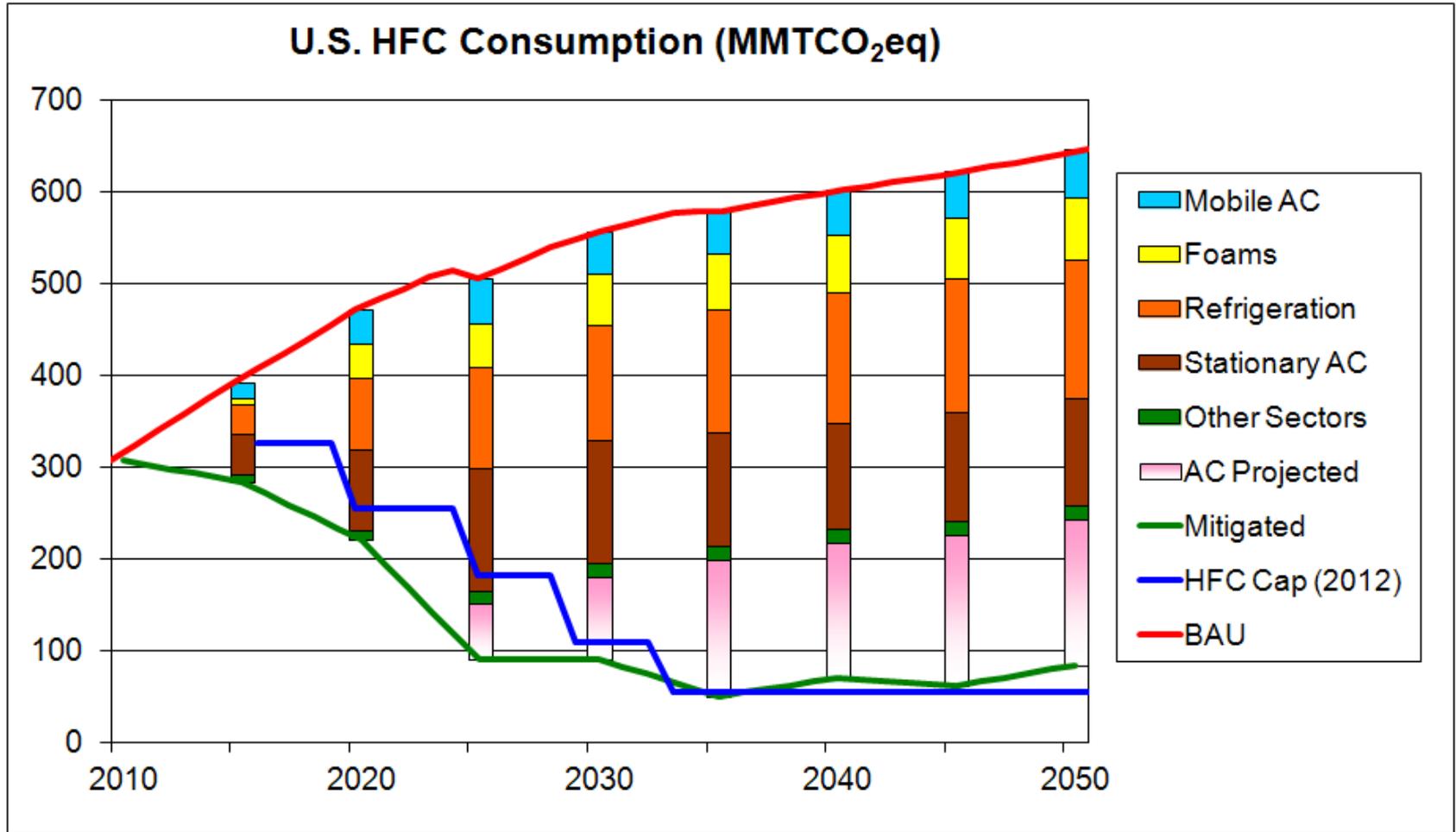


Application	Current HFC	GWP	Low GWP Options	GWP Reduction
Automotive Air Conditioning	HFC-134a	1430	Opteon® YF (HFO-1234yf)	99.7%
Residential & Light Commercial Air Conditioning	HFC-410A	2088	DR-5 DR-91	50-75%
Commercial Water Chillers	HFC-134a	1430	Opteon® XP10 DR-2	56-99%
Domestic Refrigeration	HFC-134a	1430	Opteon® YF (HFO-1234yf)	99.7%
Commercial Refrigeration	HFC-404A	3922	DR-33 DR-7	64-94%
Insulating Foam	HFC-245fa	1020	Formacel® 1100 (HFO-1336mzz)	99%

DR = Developmental Refrigerant

Application	Current HFC	GWP	Low GWP Options	GWP Reduction
Automotive Air Conditioning	HFC-134a	1430	HFO-1234yf HFC-152a CO2	91.5-99.9%
Residential & Light Commercial Air Conditioning	HFC-410A	2088	HFO/HFC blends HFC-32	50-75%
Commercial Water Chillers	HFC-134a	1430	HFOs HFO/HFC blends	58-99%
Domestic Refrigeration	HFC-134a	1430	HFOs HFO/HFC blends Hydrocarbons	99.7%
Commercial Refrigeration	HFC-404A	3922	HFO/HFC blends CO2 Hydrocarbons	64-99.9%
Insulating Foam	HFC-245fa	1020	HFOs Hydrocarbons	99%

Graph 3. Potential HFC Consumption Reductions by Sector for the United States



From: Benefits of Addressing HFCs under the Montreal Protocol, June, 2013, U.S.EPA Stratospheric Protection Division, Office of Atmospheric Programs, Office of Air and Radiation

<http://www.epa.gov/ozone/downloads/Benefits%20of%20Addressing%20HFCs%20Under%20the%20Montreal%20Protocol,%20June%202012.pdf>

- **The Scientific Case for an HFC Amendment to the Montreal Protocol is Compelling**
 - **Unregulated growth in HFC consumption could reverse the climate benefits previously achieved**
 - **An Amendment could have a cumulative climate benefit through 2050 equivalent to elimination of 15 years of current total U.S. greenhouse gas emission**
- **Options that Exist or are Under Development Would Provide the Means to Meet the Proposed Reductions**
 - **Multiple Options**
 - **Multiple Suppliers**
- **DuPont Supports the North American HFC Amendment**
 - **Science is compelling and the reductions are achievable**
 - **Business is comfortable with the Montreal Protocol**
 - **The Amendment would provide a basis for:**
 - **Consistent National regulations**
 - **A seamless transition with predictable timetable**
 - **Flexible, market based national regulations**