

# **Management of Ozone-depleting Substances Reported to the Toxics Release Inventory**

**Katherine Sleasman**

**U.S. Environmental Protection Agency**

2016 National Training Conference on the Toxics Release  
Inventory and Environmental Conditions in Communities

October 20, 2016

Washington D.C.

# Overview

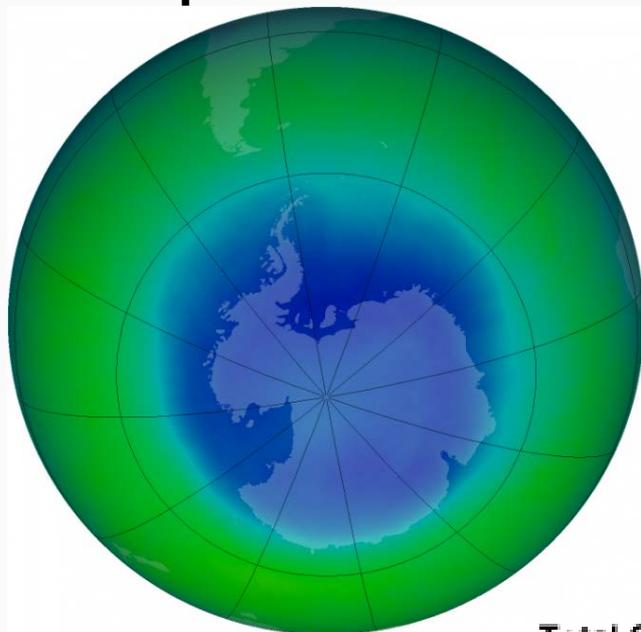


- Depletion of the Ozone Layer
- Montreal Protocol
- Clean Air Act, EPA Regulation, and Phaseout
- Ozone-depleting Substances (ODS) and Uses
- Trends in emissions using the TRI data
- Summary

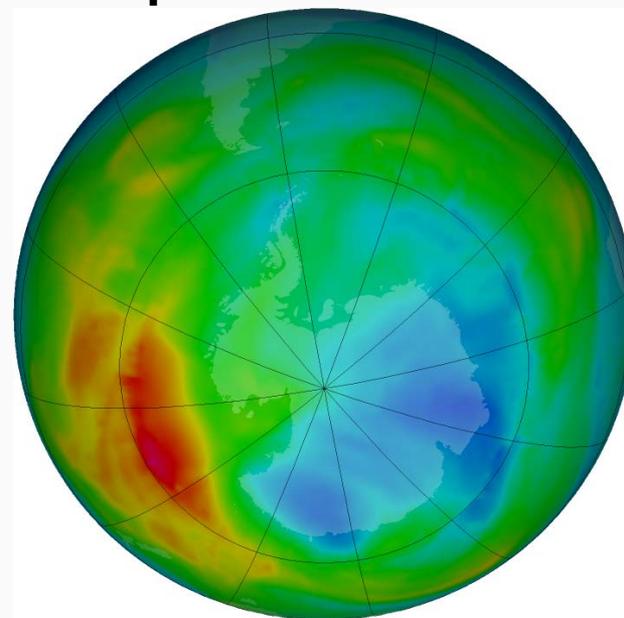
# Ozone Layer



Ozone hole over Antarctica in  
**September 1987**



Ozone hole over Antarctica in  
**September 2016**



Figures: NASA

- Increased levels of human-produced gases such as CFCs (chlorofluorocarbons) have led to increased rates of ozone destruction, upsetting the natural balance of ozone and leading to reduced stratospheric ozone levels. These reduced ozone levels have increased the amount of harmful ultraviolet radiation reaching Earth's surface.

# Montreal Protocol



- Collaborative, international effort to regulate and phase out ozone-depleting substances (ODS)
- U.S. ratified the Montreal Protocol in 1988
- Parties reduce and eliminate ODS consumption in a step-wise manner
- Recovery of the ozone layer to pre-1980 levels expected during the middle of this century

# Framework for ozone layer protection



- 1987: Montreal Protocol signed
  - Widely referred to as the most successful environmental treaty ever
    - International recognition of problem based on sound science
    - Predictable, cost-effective phasedown of the production and consumption of ODS, with assistance for developing countries
  - U.S. continues as leader
  - 20<sup>th</sup> anniversary brought more aggressive controls
  - New focus on addressing non-ozone depleting greenhouse gases
- 1990: Clean Air Act Amendments – Title VI
  - Implements the Montreal Protocol's phaseout
  - Provides additional tools:
    - 608: Stationary cooling
    - 609: Motor vehicles
    - 610: Nonessential products ban
    - 611: Labeling
    - 612: Significant New Alternatives Policy
- EPA's Regulatory Framework – 40 CFR Part 82
  - Phasedown, exemptions implemented through allowances for production and import

# Ozone-depleting Substances Reported to TRI



- Many Class I and Class II ozone-depleting substances are included on the TRI chemical list, and hence, the quantities released to the environment or otherwise managed as waste are reportable to EPA's TRI Program.

| Class I ODS       | TRI Chemical Name                   | ODP | 100-year GWP |
|-------------------|-------------------------------------|-----|--------------|
| CFC-11            | Trichlorofluoromethane              | 1   | 4750         |
| CFC-12            | Dichlorodifluoromethane             | 1   | 10900        |
| CFC-13            | Chlorotrifluoromethane              | 1   | 14420        |
| CFC-113           | Freon 113                           | .8  | 6130         |
| CFC-114           | Dichlorotetrafluoroethane (CFC-114) | 1   | 10000        |
| CFC-115           | Monochloropentafluoroethane         | .6  | 7370         |
| Halon 1211        | Bromochlorodifluoromethane          | 3   | 1890         |
| Halon 1301        | Bromotrifluoromethane               | 10  | 7140         |
| Halon 2404        | Dibromotetrafluoroethane            | 6   | 1640         |
| CCL <sub>4</sub>  | Carbon tetrachloride                | 1.1 | 1400         |
| Methyl Chloroform | 1,1,1-trichloroethane               | .1  | 146          |
| Methyl bromide    | Bromomethane                        | .7  | 5            |

# Ozone-depleting Substances Reported to TRI



| Class II ODS | TRI Chemical Name                         | ODP  | 100-year GWP |
|--------------|---|------|--------------|
| HCFC-21      | Dichlorofluoromethane                     | .04  | 151          |
| HCFC-22      | Chlorodifluoromethane                     | .055 | 1810         |
| HCFC-121     | 1,1,2,2-tetrachloro-1-fluoroethane        |      | 100          |
| HCFC-123     | 2,2-dichloro-1,1,1-trifluoroethane        | .02  | 77           |
| HCFC-123a    | 1,2-dichloro-1,1,2-trifluoroethane        |      | 77           |
| HCFC-123b    | 1,1-dichloro-1,2,2-trifluoroethane        |      | 77           |
| HCFC-124     | 2-chloro-1,1,1,2-tetrafluoroethane        | .022 | 609          |
| HCFC-124a    | 1-chloro-1,1,2,2-tetrafluoroethane        |      | 609          |
| HCFC-132b    | 1,2-dichloro-1,1-difluoroethane           |      | 100          |
| HCFC-133a    | 2-chloro-1,1,1-trifluoroethane            |      | 100          |
| HCFC141b     | 1,1-dichloro-1-fluoroethane               | .011 | 725          |
| HCFC-142b    | 1-chloro-1,1-difluoroethane               | .065 | 2310         |
| HCFC-225ca   | 3,3-dichloro-1,1,1,2,2-pentafluoropropane | .025 | 122          |
| HCFC-225cb   | 1,3-dichloro-1,1,2,2,3-pentafluoropropane | .033 | 595          |
| HCFC-253     | 3-chloro-1,1,1-trifluoropropane           |      |              |

# Uses of Ozone-depleting Substances Class I and II



- **Examples:** CFCs, halons, carbon tetrachloride, methyl bromide, and methyl chloroform, and HCFC -22, -123, -124, -141b, -142b
- **Uses include:**
  - Solvents
  - Refrigerants
  - Pesticides and Lab Use
  - Fire Suppression Agents
  - Foams
  - Aerosols
  - Process Agents
  - Feedstock – building blocks used to produce other chemicals, such as HFCs and fluoropolymers



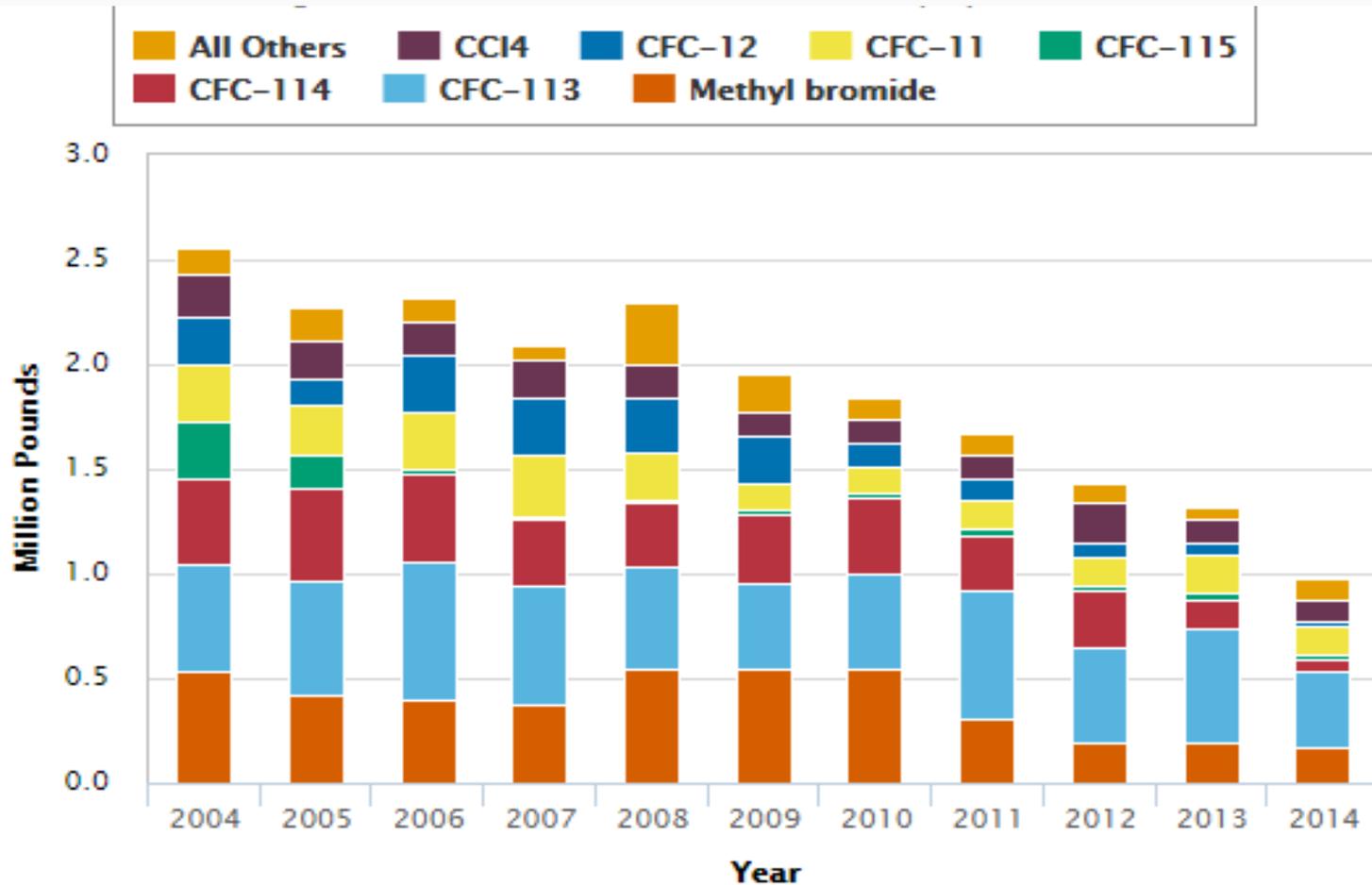
# Class I and II Phaseout Schedule



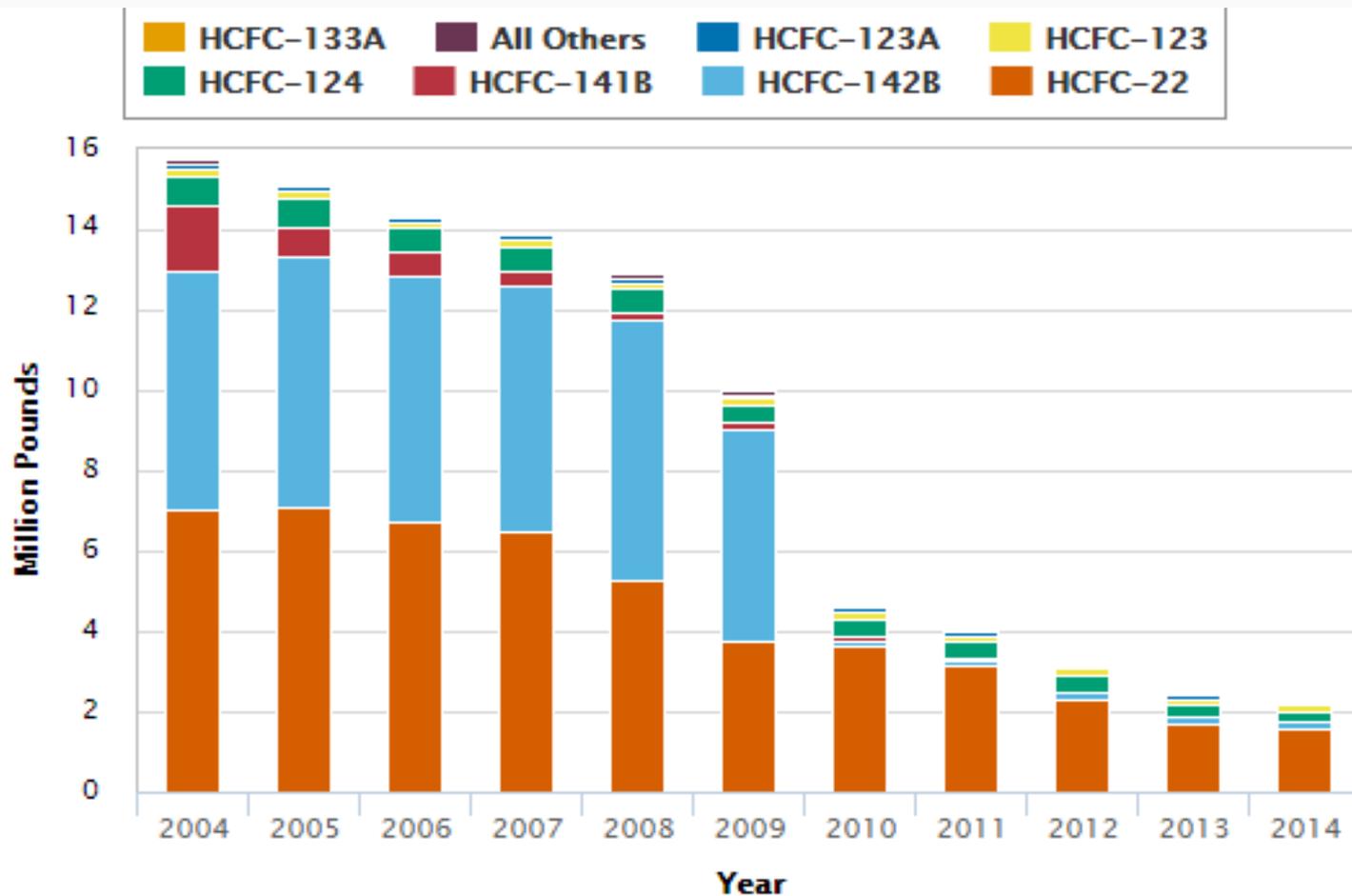
- Class I substances have been phased out

| Date        | Cap and Reductions to the Cap   | ODP Weighted Quantity           |
|-------------|---|---------------------------------|
| Jan 1, 1996 | Consumption freeze capped at 2.8% of the ODP of the CFC plus HCFC consumption in 1989 | 15,240 metric tons (33.6 M lbs) |
| Jan 1, 2004 | 35% reduction to the cap  | 9,906 metric tons (21.8 M lbs)  |
| Jan 1, 2010 | 75% reduction to the cap  | 3,810 metric tons (8.4 M lbs)   |
| Jan 1, 2015 | 90% reduction to the cap  | 1,524 metric tons (3.36 M lbs)  |
| Jan 1, 2020 | 99.5% reduction to the cap  | 76.2 metric tons (167,992 lbs)  |
| Jan 1, 2030 | 100% reduction to the cap   | 0 metric tons (0 lbs)           |

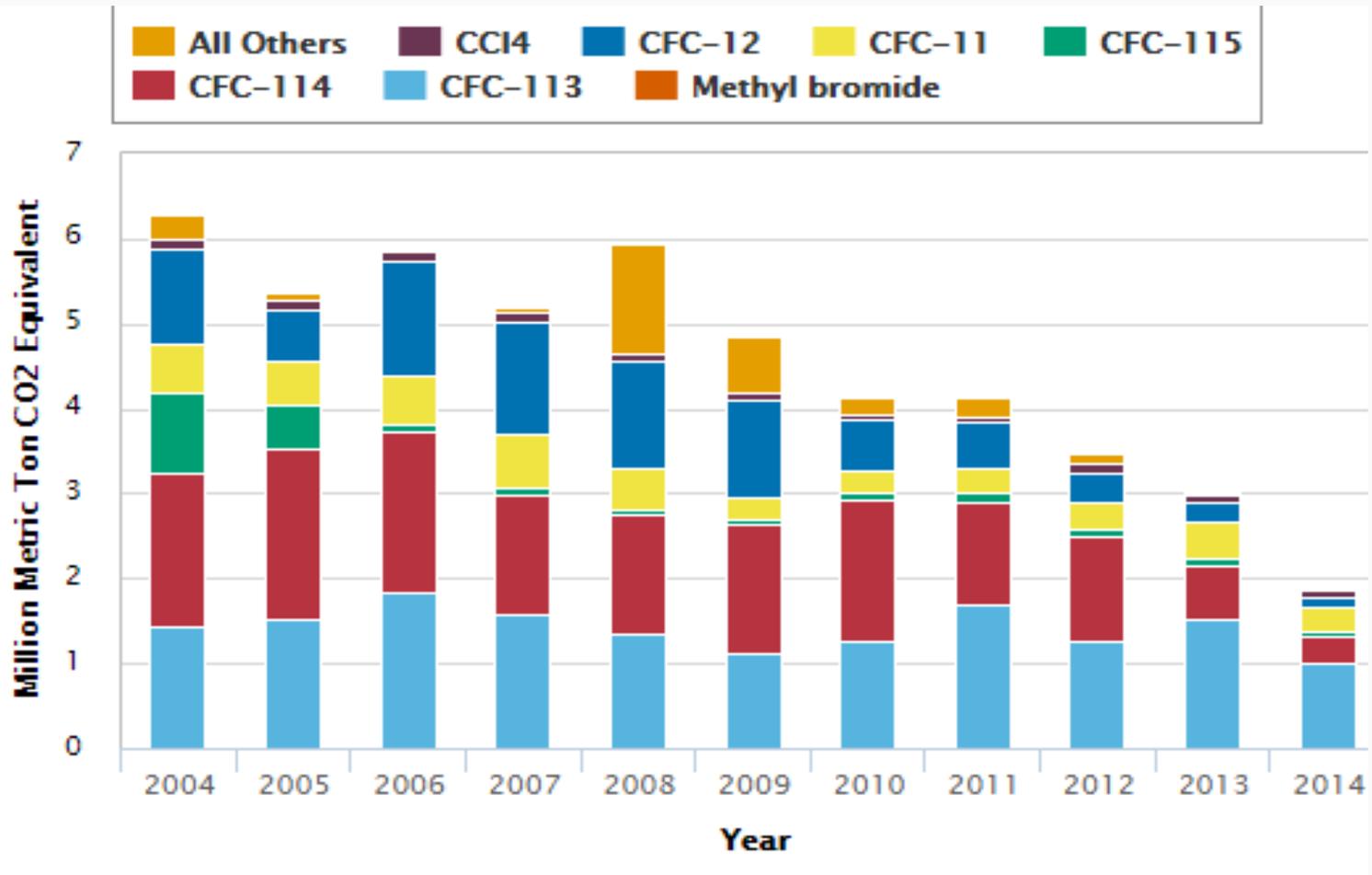
# Class I Ozone-depleting Substances Emissions



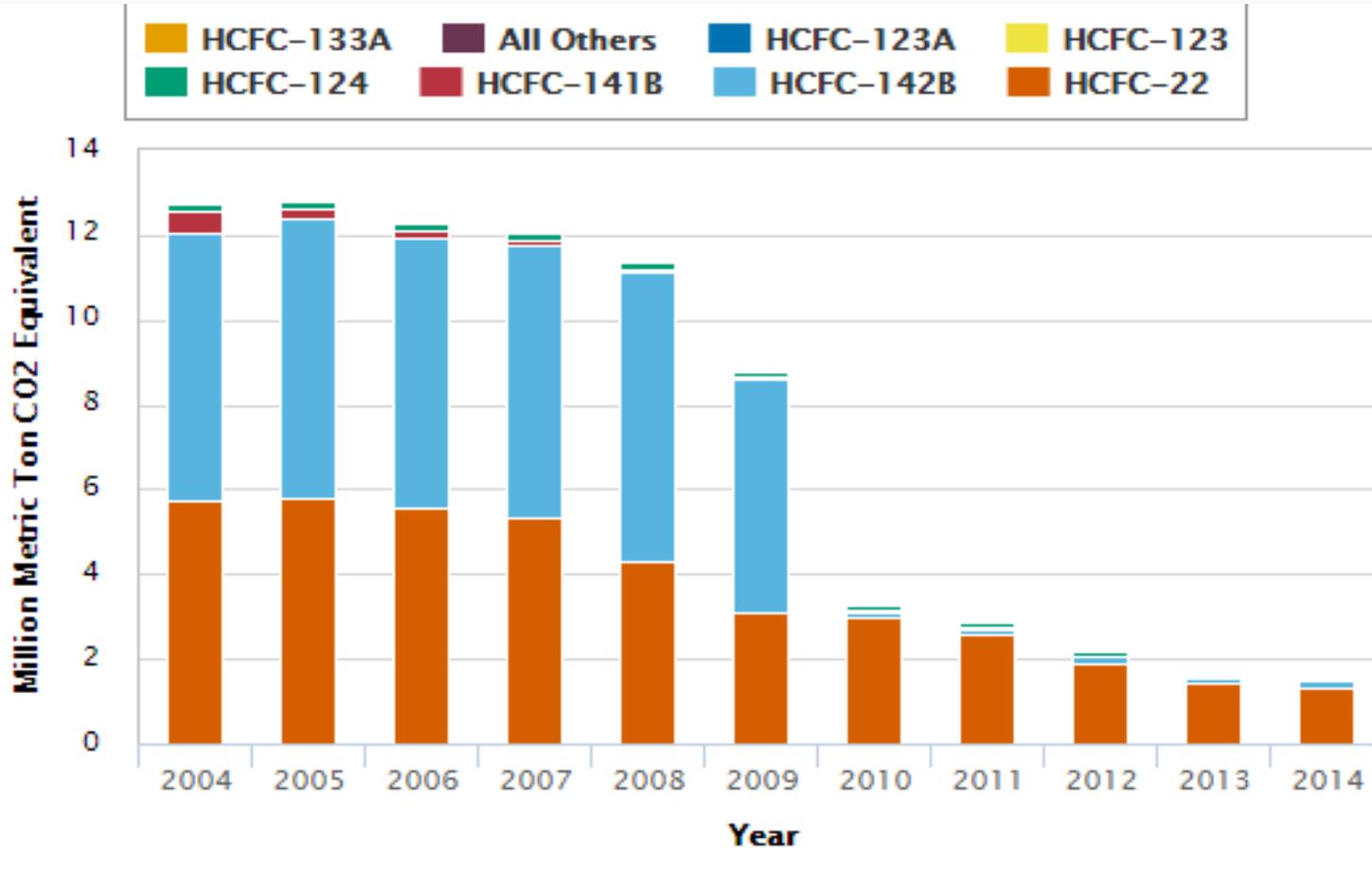
# Class II Ozone-depleting Substances Emissions



# GWP-weighted Emissions for Class I Ozone-depleting Substances



# GWP-weighted Emissions for Class II Ozone-depleting Substances



# Summary



- U.S. implementation of the Montreal Protocol has been successful in reducing production and consumption of ozone-depleting substances
  - Adopted in 1987, now 197 signatories
  - Ozone layer expected to recover in mid-century
  - Dramatic health protection from ozone layer recovery
    - EPA estimates 1.6M deaths from skin cancer prevented in Americans born through 2100
- Substantial climate benefits



Thank You

Questions?

**Katherine Sleasman**  
Stratospheric Protection Division  
U.S. Environmental Protection Agency  
Office: 202-564-7716  
Email: [sleasman.katherine@epa.gov](mailto:sleasman.katherine@epa.gov)