Update on US Greenhouse Gas Reporting Program

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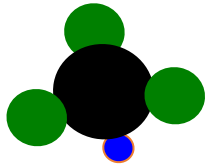
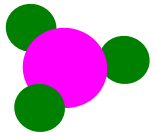
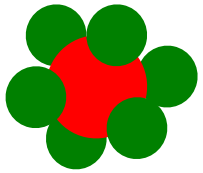
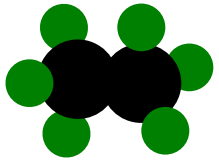
Overview

- Background
  - SF_6 and PFCs: potent and long-lived GHGs
  - Global and US SF_6 emission trends
- Greenhouse Gas Reporting Program
  - Requirements
  - Nameplate capacity estimates and emissions calculations
  - Reported trends

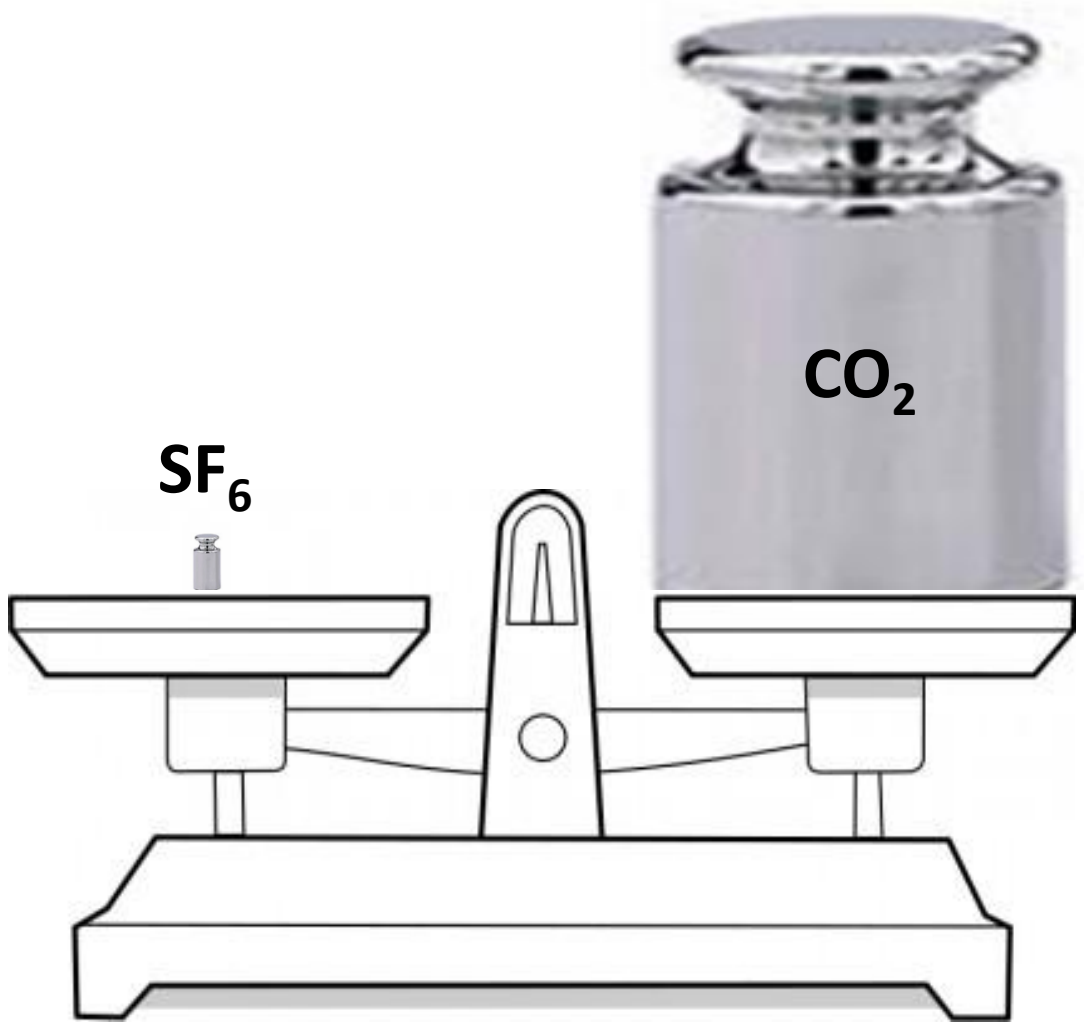
Fluorinated GHGs: Potent, Often Long-Lived GHGs

Chemical Type	GWPs	Lifetimes (years)	Sources
HFCs 	100-15,000	1-240	Air-conditioning/refrig. and other ODS substitute uses F-GHG production Electronics
NF_3 	17,200	500	Electronics production F-GHG production
SF_6 	22,800	3,200	Electrical T&D equipment Electronics Magnesium production F-GHG production
PFCs 	7,000-17,000	2,500-50,000	Electronics production Aluminum production F-GHG production

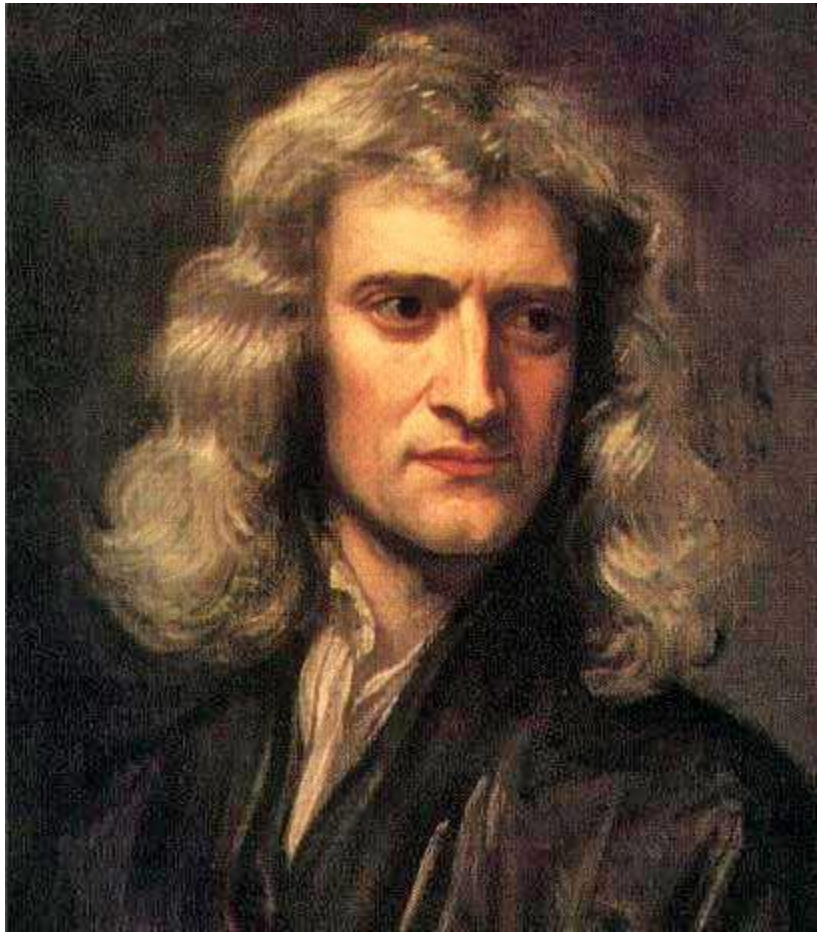
Implications of high GWPs

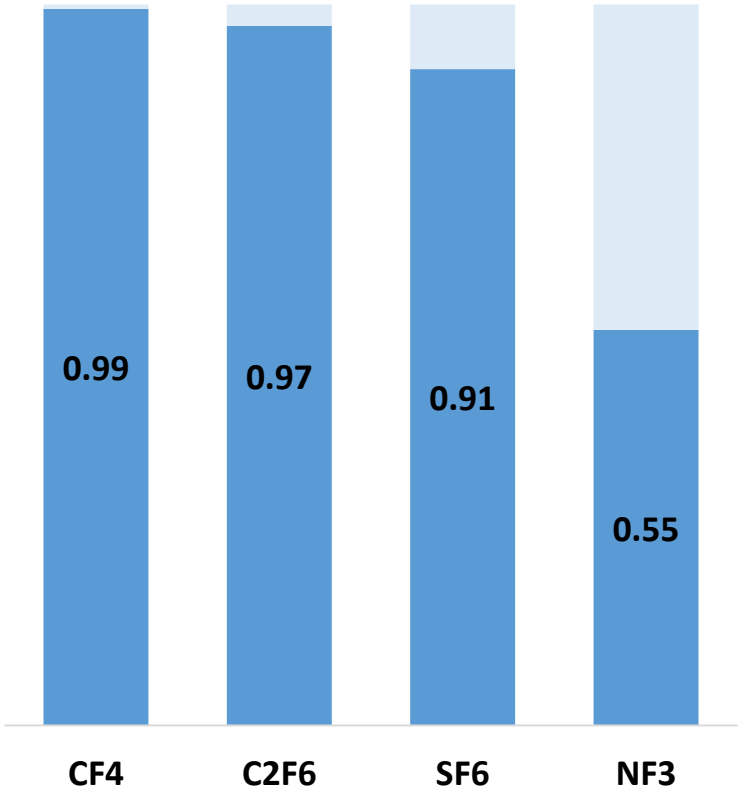
1 pound of SF_6
= 11.4 tons of CO_2;

1 ounce of SF_6
= 0.7 tons of CO_2

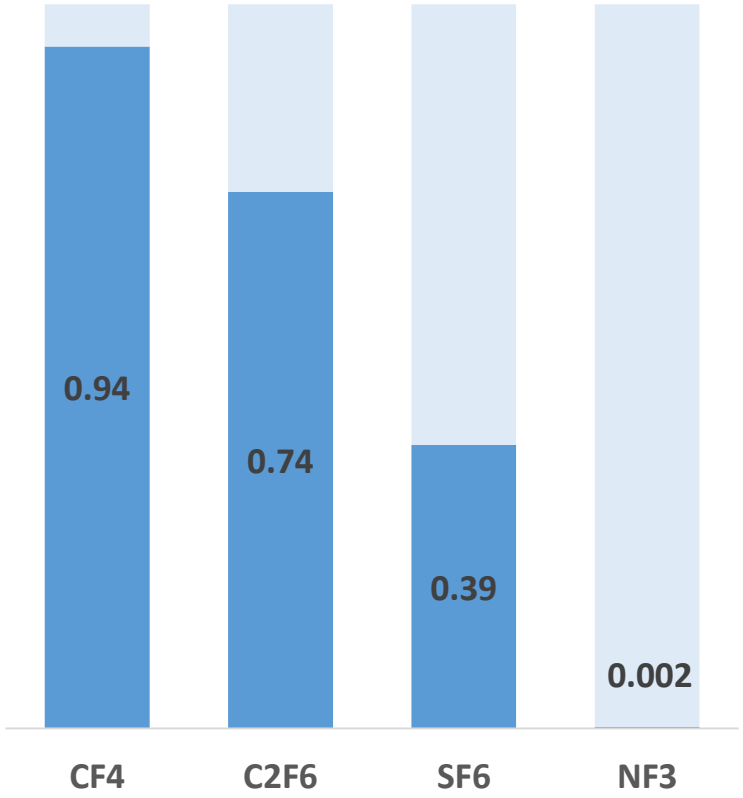


Fractions of Gas Remaining after 300 years

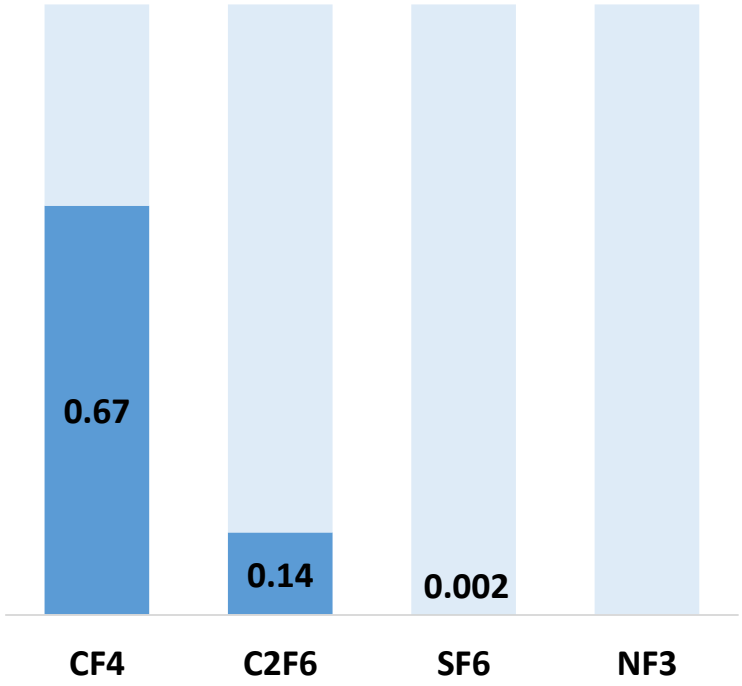




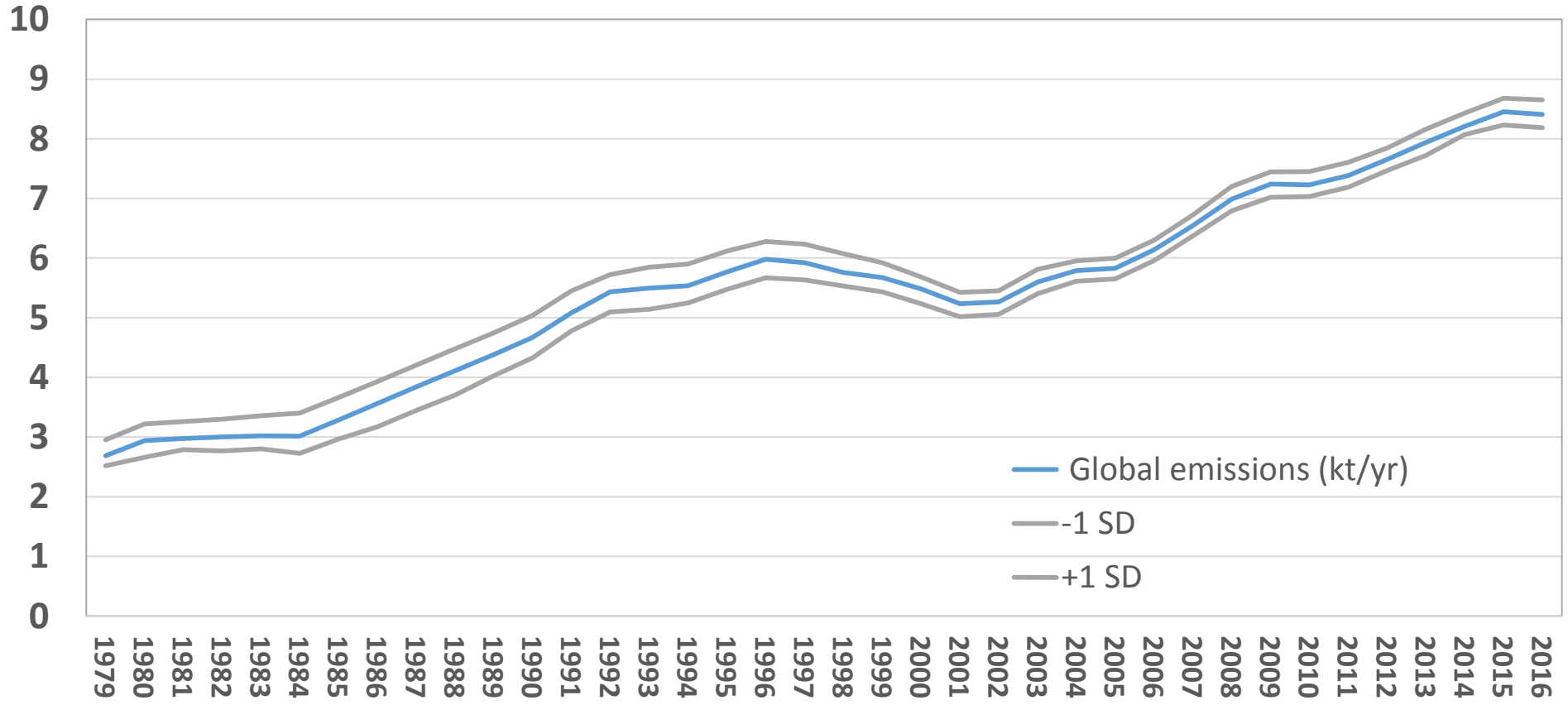
. . . after 3,000 years (since era of Ramses II)



. . . after 20,000 years (age of Lascaux drawings)

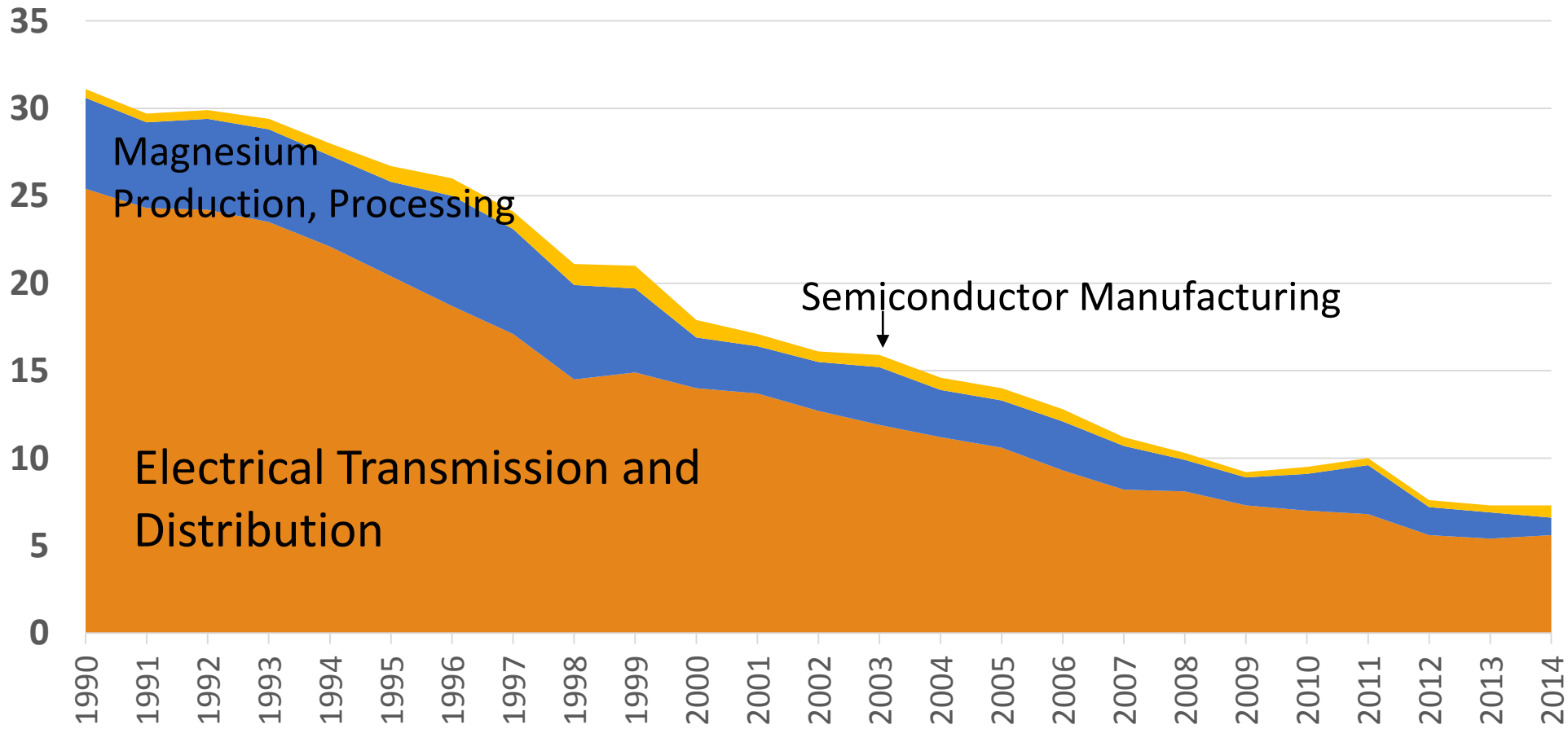


Global SF_6 Emissions Inferred from Atmospheric Measurements, 1978-2015 (kt per year)



Source: Rigby, M., et al. (2014), "Recent and future trends in synthetic greenhouse gas radiative forcing," Geophys. Res. Lett., 41, 2623–2630. Updated by Rigby to include 2013-2015 (1/17/17).

US SF_6 Emissions from Major Sources, 1990-2014 ($MMTCO_2e$)



Source: U.S. Inventory of GHG Emissions and Sinks: 1990-2014.

The Greenhouse Gas Reporting Program

- Annual Reporting Program
  - 41 source categories, accounting for about 85-90% of U.S. GHG emissions
- Reporting threshold of 25,000 metric tons CO_2 equivalent (CO_2e) or more per year for most sources
- Direct reporting to EPA electronically
- EPA verification of GHG data

Four Subparts (Sections) of GHGRP Relevant to Electrical T&D Equipment

- Subpart DD: Electrical Transmission and Distribution Equipment Use
  - Report emissions and related quantities if system nameplate capacity exceeds 17,820 pounds.
- Subpart SS: Electrical Equipment Manufacture or Refurbishment
  - Report emissions and related quantities if total annual purchases of SF_6 and PFCs exceed 23,000 pounds.
- Subpart OO: Suppliers of Industrial Greenhouse Gases
  - Report bulk imports and exports of SF_6, other F-GHGs, N_2O, and CO_2 if you import or export a total of 25,000 $mtCO_2e$ or more of these gases (e.g., 1.1 metric tons SF_6)
- Subpart QQ: Importers and Exporters of FGHGs in Pre-Charged Equipment
  - Report imports and exports of SF_6 and other F-GHGs if you import or export equipment or closed-cell foams containing a total of 25,000 $mtCO_2e$ or more of these gases.

e-GGRT
Electronic Greenhouse Gas Reporting Tool

Calculating GHG Emissions

Subpart DD – Eq. DD-1

- *User Emissions = (Decrease in Storage Inventory) + (Acquisitions) – (Disbursements) – (Net increase in Total Nameplate Capacity of Equipment Operated)*

- The net increase of nameplate capacity is determined by taking the nameplate capacity of new equipment and subtracting the nameplate capacity of retiring equipment

Subpart SS – Eq. SS-1

- *User Emissions = (Decrease in Storage Inventory) + (Acquisitions) – (Disbursements)*

Subpart SS – Eq. SS-6

- *Emissions from Equipment Installation = (Total Mass used to Fill Equipment) + (Total Mass used to charge Equipment Prior to Leaving the Manufacturer Facility) – (Total Nameplate Capacity Installed at Electric T&D Facility)*

e-GGRT Electronic Greenhouse Gas Reporting Tool

Mass-Balance Method

- Can be performed at facility level or at equipment level.
  - GHGRP interested in facility-level emissions; thus, requires facility-level version. However, to identify and track emissions at the equipment level, the equations on the following slide can be used.
- Can lead to apparent “bumpiness” in emissions because losses that occur over several years are all detected at once, when equipment is serviced or retired.
  - May be issue for smaller facilities w/few pieces of equipment
- Accuracy depends on accurate estimates of nameplate capacity of new and retiring equipment.

Mass-Balance Method by Lifecycle Stage

The more detailed approach provides three equations to estimate emissions, one for each lifecycle stage:

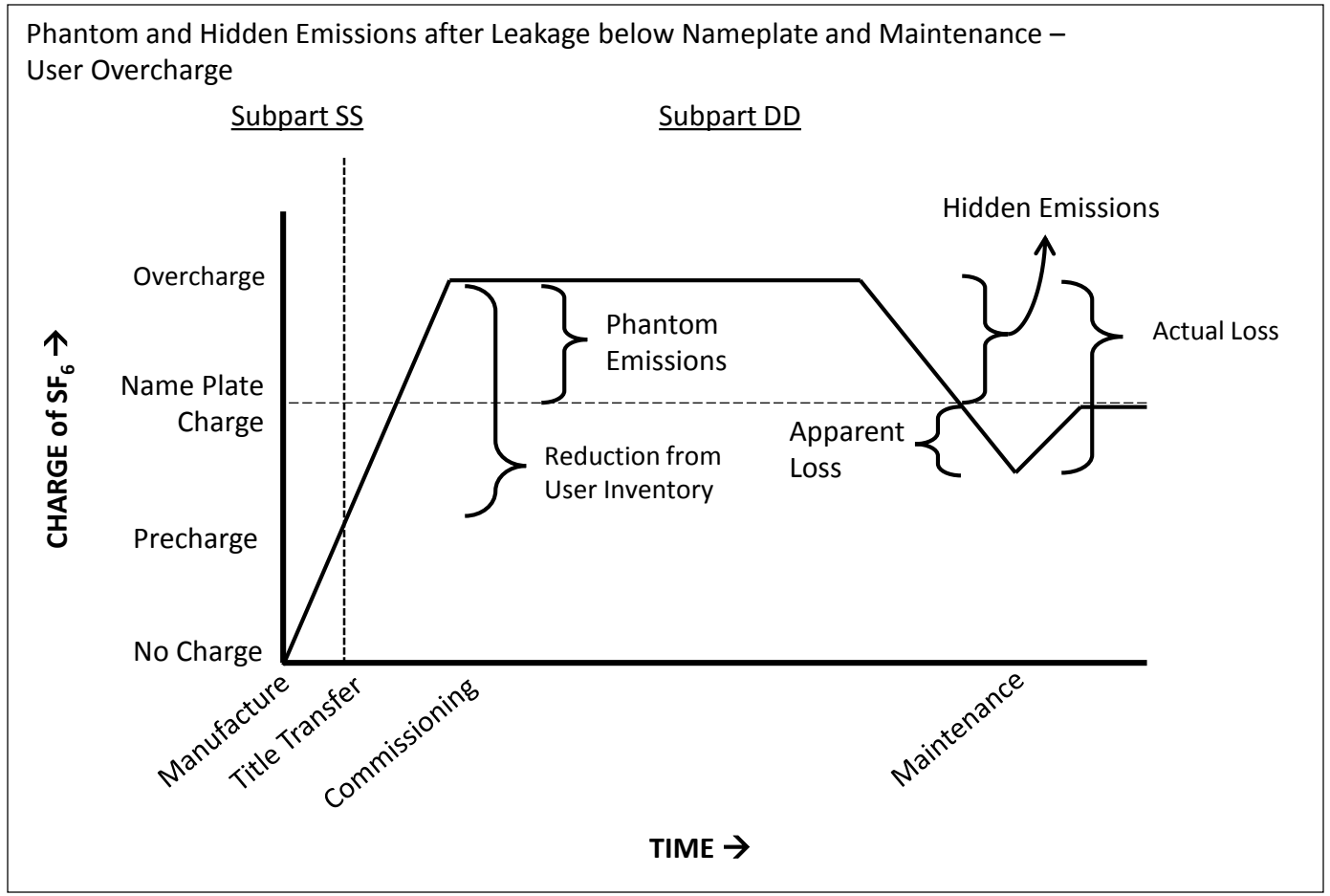
- **Equipment Installation Emissions** = SF_6 used to fill equipment - Nameplate capacity of new equipment
- **Equipment Use Emissions** = SF_6 used to recharge equipment at servicing – SF_6 recovered from equipment at servicing
- **Disposal and final use emissions** = Nameplate capacity of retired equipment – SF_6 recovered from retired equipment

This approach is mathematically equivalent to facility-level approach, and can be found in the 2006 IPCC Guidelines, Volume 3, Chapter 8.

Nameplate Capacity Considerations

- Accurate nameplate capacities of *new* and *retiring* equipment are key to accurate calculation of emissions using mass-balance approach.
  - Nameplate capacity of other equipment doesn't affect mass-balance calculation, although it does affect calculated emission rates.
  - Note that an *adjustment* to the *stated* nameplate capacity is different from an actual *change* to the nameplate capacity ($NC_{new} – NC_{retiring}$)
- Stated nameplate capacity of new equipment generally expected to be accurate.
- Stated nameplate capacity of retiring equipment may need to be corrected.
  - Trained technicians, appropriate SF_6 recovery practices, and properly calibrated weigh scales, flowmeters, and/or gauges are critical to obtaining an accurate revised nameplate capacity estimate.

Phantom Emissions Balanced by Hidden Emissions



Recent Revisions to Subpart DD

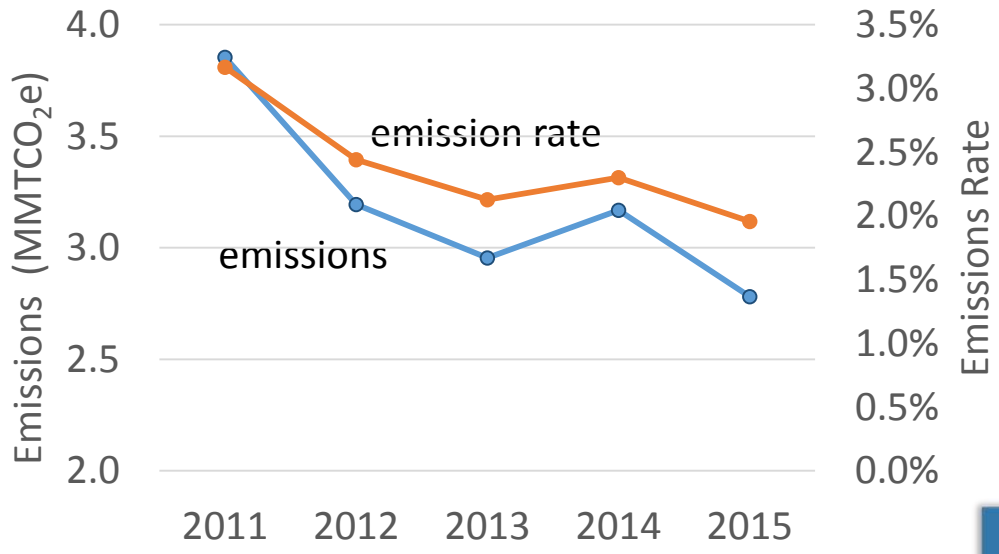
Starting with RY 2017 reports (due by April 2, 2018):

- Report state(s) or territory in which electric power system lies.
- When reporting the quantities of equipment installed and retired each year,
  - Distinguish between hermetically sealed equipment and other equipment, and
  - Report numbers of pieces as well as nameplate capacities of each type of equipment.

Subpart DD Reported Data at a Glance

	2011	2012	2013	2014	2015
Number of Reporters	123	123	121	118	105
Emissions ($MMTCO_2e$)	3.85	3.19	2.95	3.17	2.78
Annual Emission Changes		-17.1%	-7.5%	7.2%	-12.2%
Total Emission Changes		-17.1%	-23.4%	-17.8%	-27.9%
Emission Rate	3.17%	2.44%	2.13%	2.30%	1.96%

- Over the five years of the reporting program, there has been a 30.5 percent reduction in emissions
- The highest emitters* reduced emissions by more than all other reporters combined between 2011 and 2015.
- Spike in 2014 emissions was due to in part to a leak at one site.

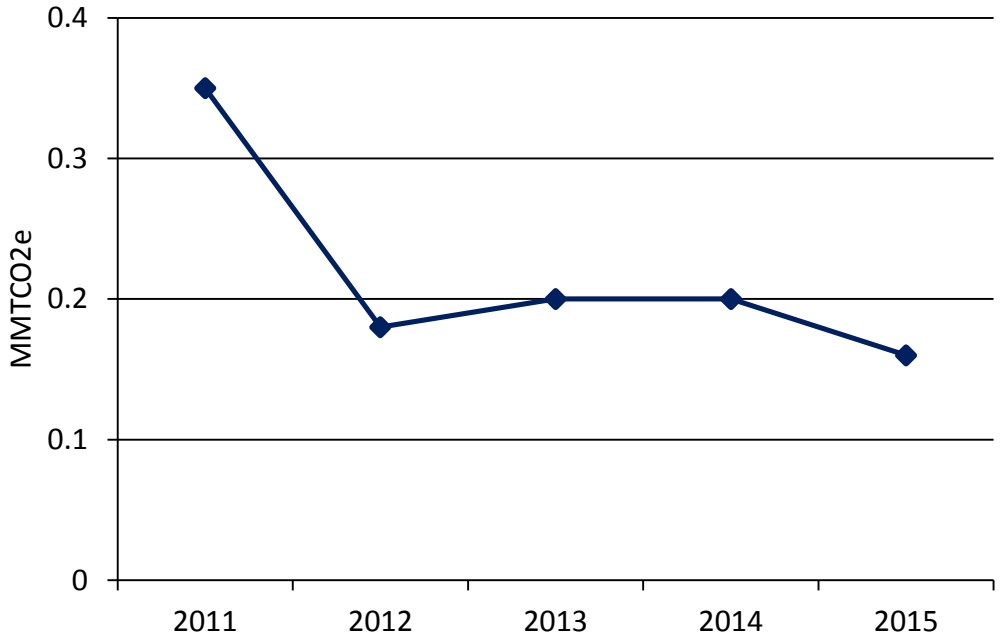


* The highest emitters are defined as the subset of reporters who were the top 10% emitters in 2011. This group was held constant between 2011 and 2015 and their reductions were tracked accordingly.

Subpart SS Reported Data at a Glance

	2011	2012	2013	2014	2015
Number of Reporters	6	6	6	7	7
Emissions ($MMTCO_2e$)	0.35	0.18	0.20	0.20	0.16
Annual Emission Changes		-49.2%	+12.9%	+1.8%	-21.3%
Total Emission Changes		-49.2%	-42.7%	-41.6%	-54.1%

- **Over the five years of the reporting program, there has been a 54.1 percent reduction in emissions**
- **Almost all of the emission reductions attributed to one reporter between the first and second year of reporting**



For Additional Information

- Visit: https://www.epa.gov/ghgreporting
  - Information and resources for reporting facilities
  - GHGRP Data