Global changes in atmospheric concentrations of HFCs and HCFCs: assessing the effects of international policy

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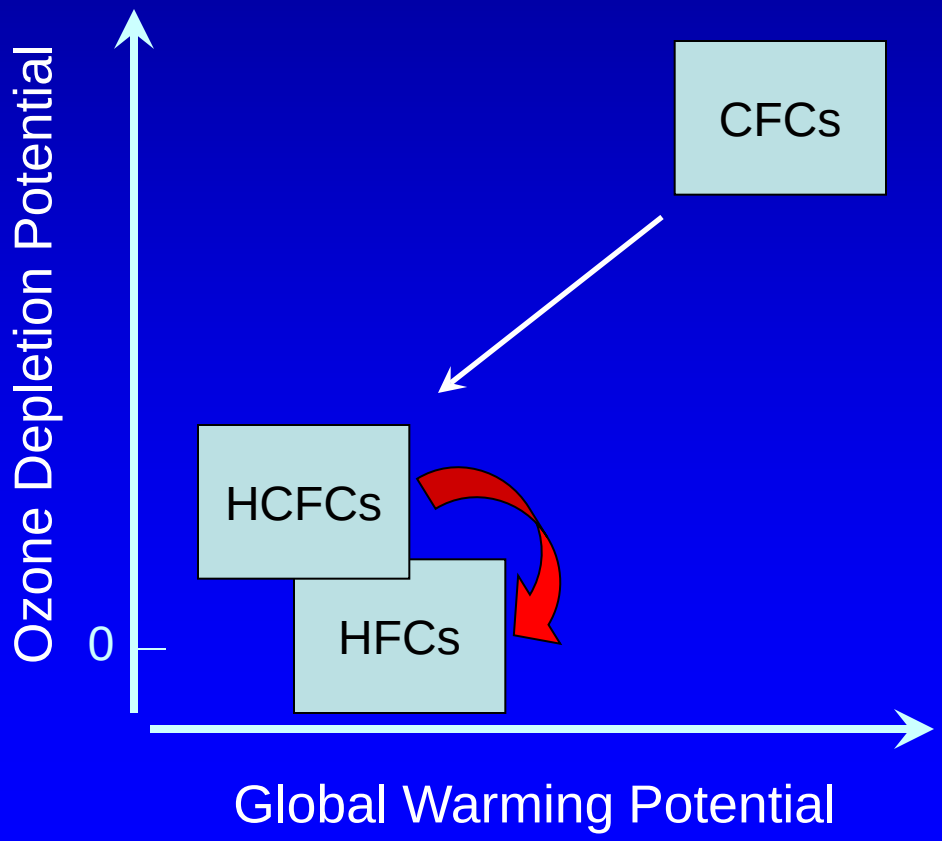
The Montreal Protocol on Substances that Deplete the Ozone Layer

→ *Set phase-out schedules for potent ozone-depleting gases (e.g., CFCs)*

→ *The transition from HCFCs to HFCs is currently underway…*



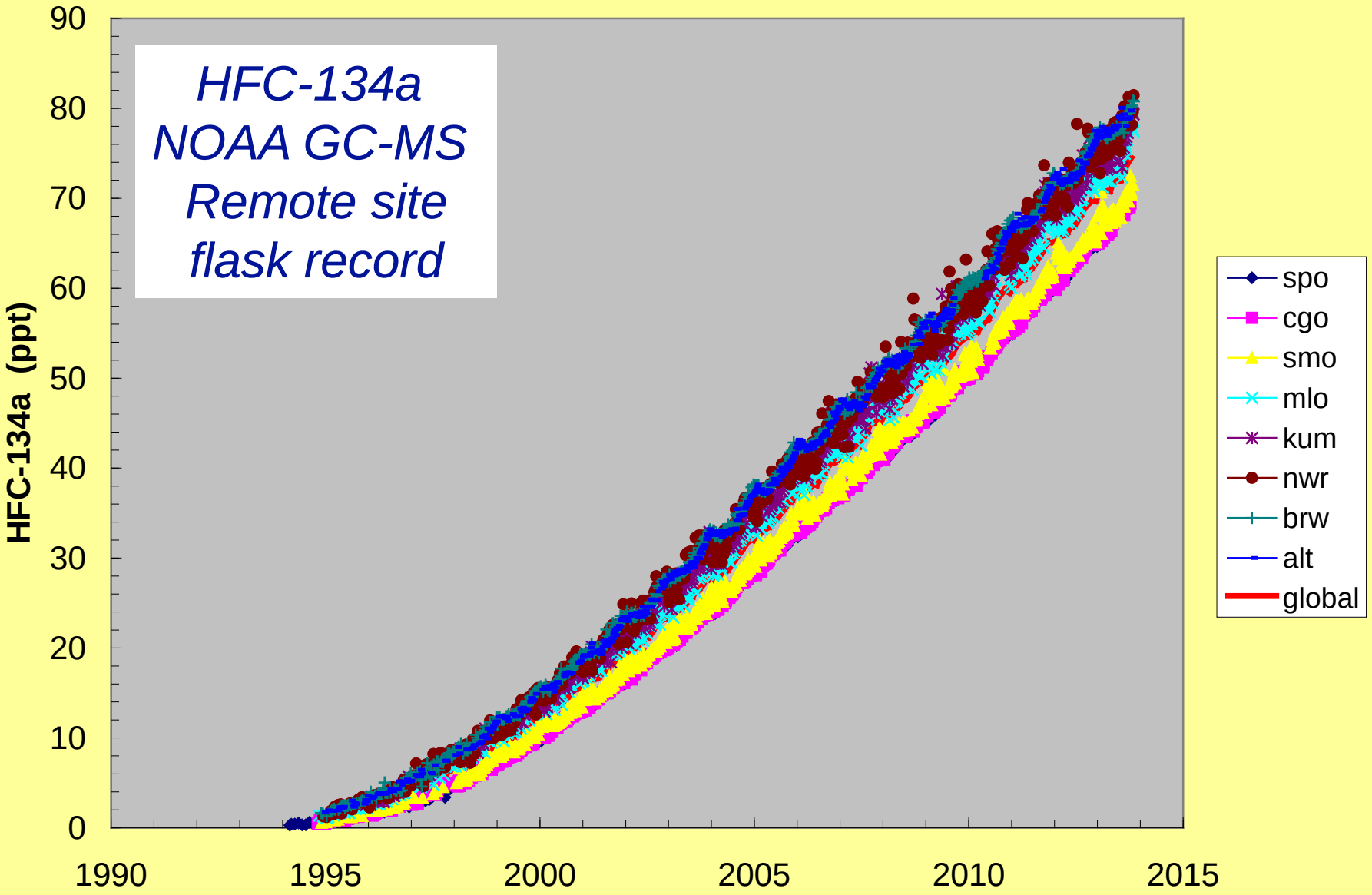
This transition was accelerated by the 2007 Adjustments to the Montreal Protocol:

1) Capped ***HCFC*** production in developing countries for the first time (as of 1 Jan 2013)

2) Could lead to large increases in ***hydrofluorocarbons (HFCs)***, particularly in developing countries (Velders *et al*., 2009), and radiative forcing…

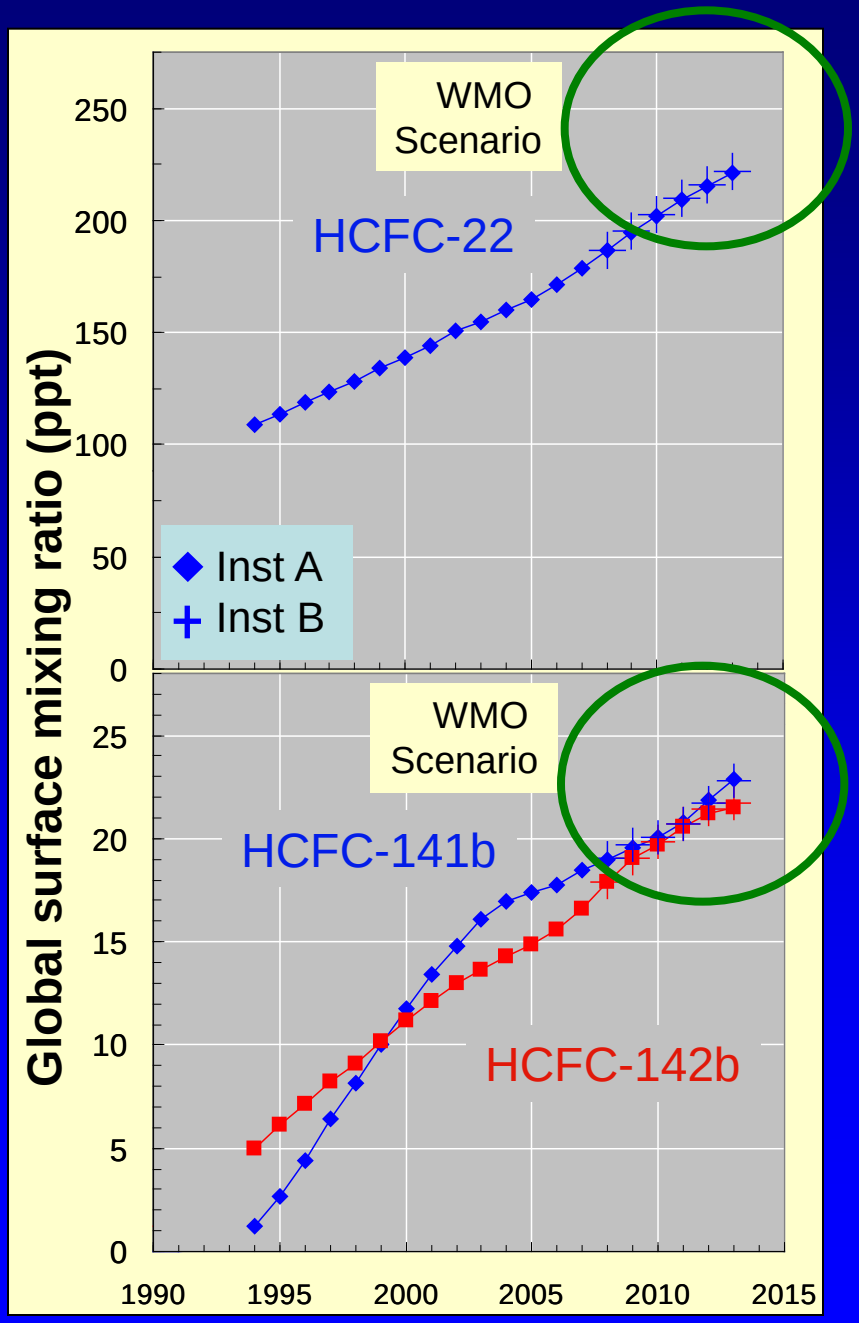
→ *How have concentrations and emissions of **HCFCs** and **HFCs** changed in response?*

Halocarbon Surface and Aircraft Sampling Network



SPO

Global Surface Mixing Ratios



Despite the 2007 Adjustments:

HCFC concentrations are still increasing

…as is total chlorine and radiative forcing from these chemicals

Growth rates have changed as production shifted from developed to developing countries (~2004)…

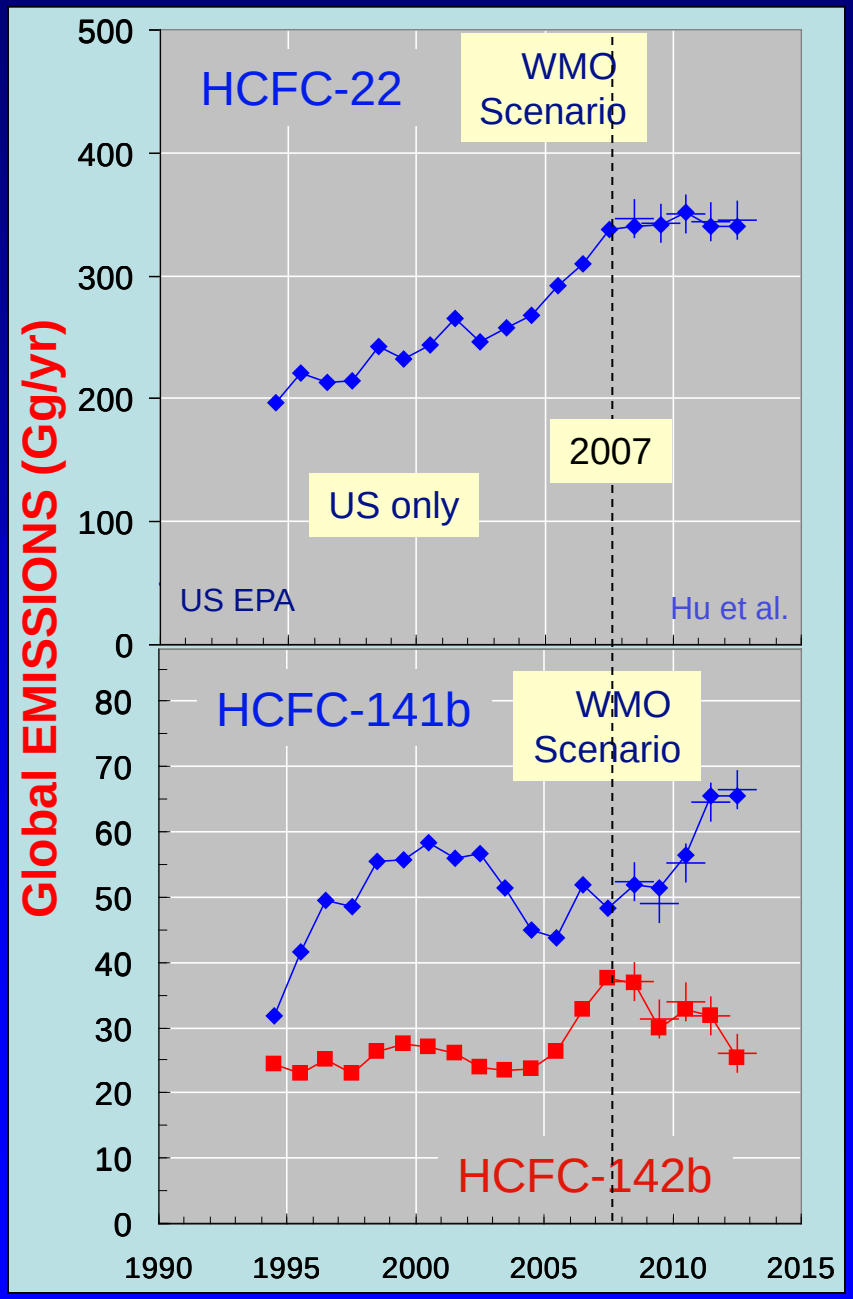
But:

Increases since 2007 compared to WMO scenario are:

* slower for HCFC-22 and -142b,
* as projected for HCFC-141b

(WMO Scenarios from Velders and Daniel et al., 2011)

Global EMISSION rates derived from global changes



Since 2007:

Global emissions have:

-***remained constant*** for HCFC-22

-***decreased*** for HCFC-142b

-***increased*** for HCFC-141b

Compared to the WMO Scenario:

Actual emissions were

-***smaller*** for HCFC-22 and HCFC-142b

-***similar*** for 141b

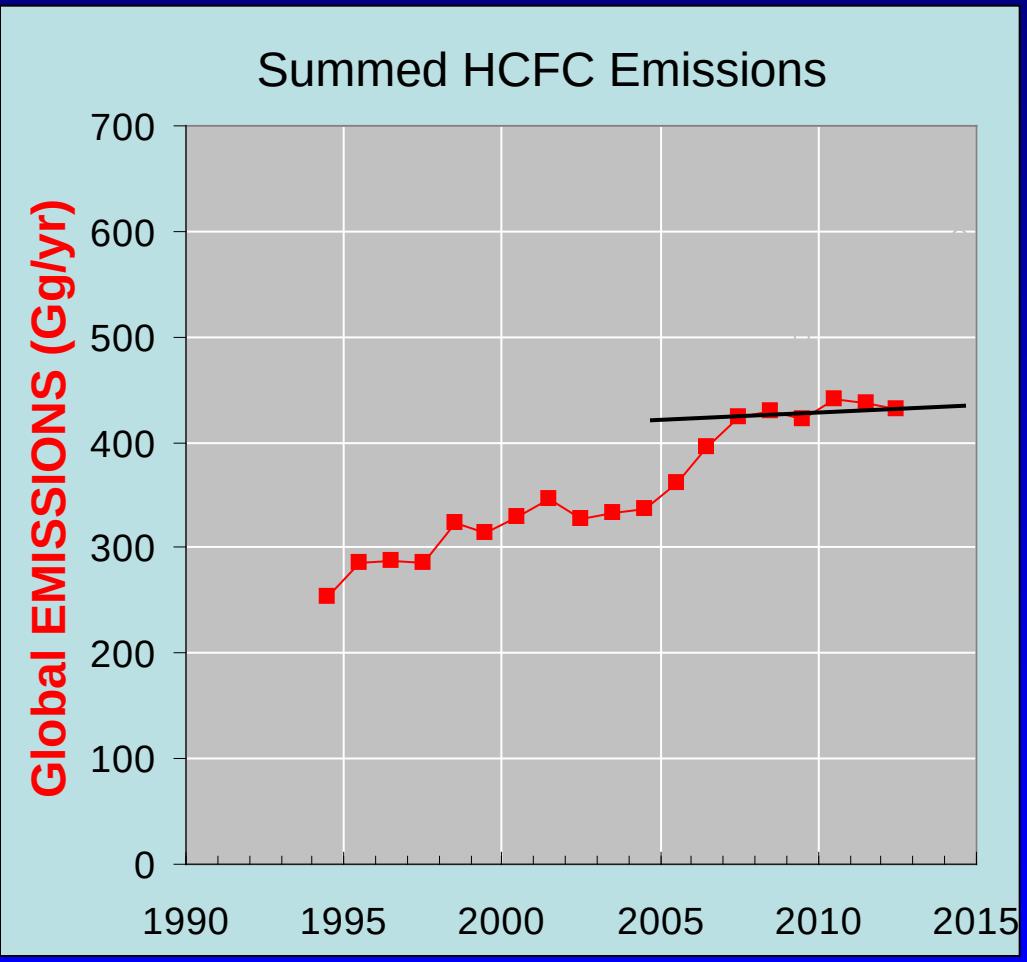
US HCFC-22 emissions (EPA and Hu *et al.*):

* increased in the past… decreasing now?

→ Are decreases in developed countries now offsetting increases in developing countries?

Hu et al.: following talk

Summed Global HCFC EMISSIONs



Since 2007 when the Adjustments to the Montreal Protocol were agreed to:

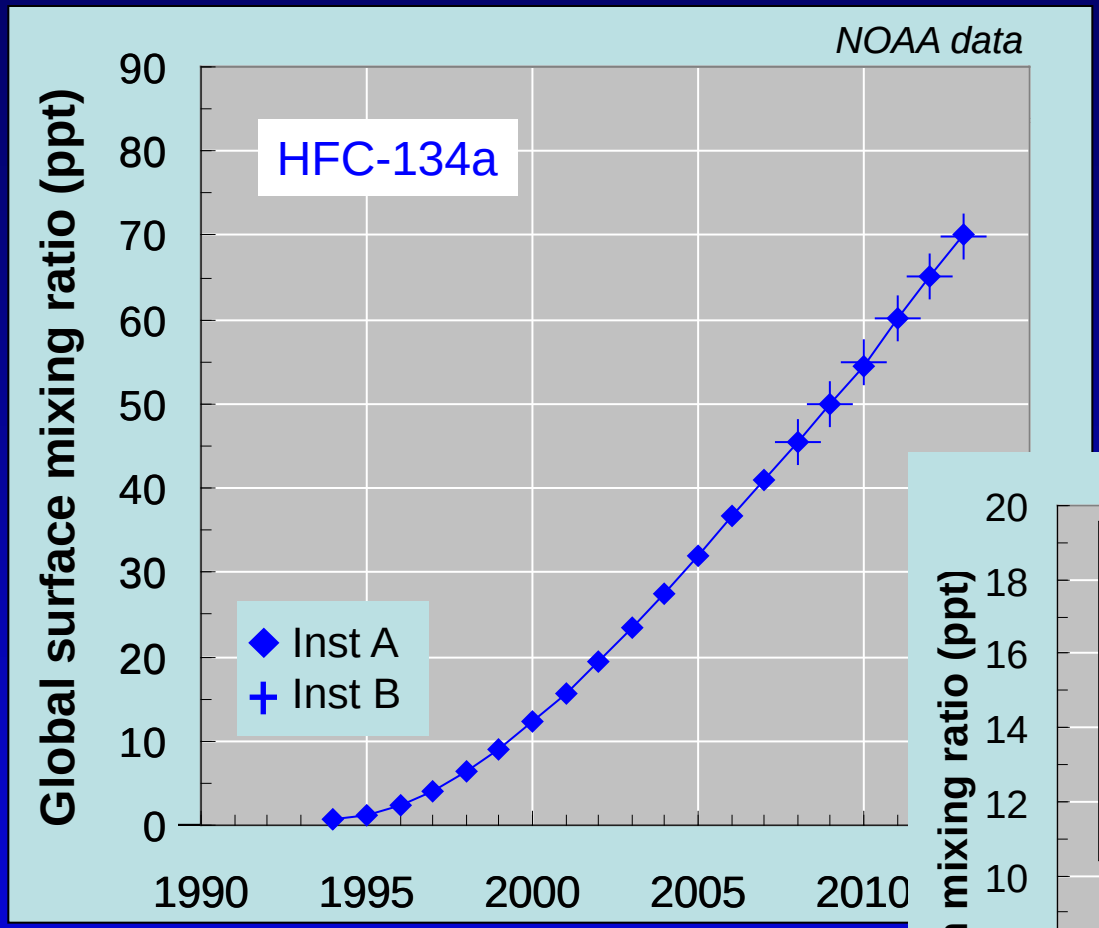
Global HCFC emissions have remained nearly constant

…even though global production limits applied only after Jan 2013

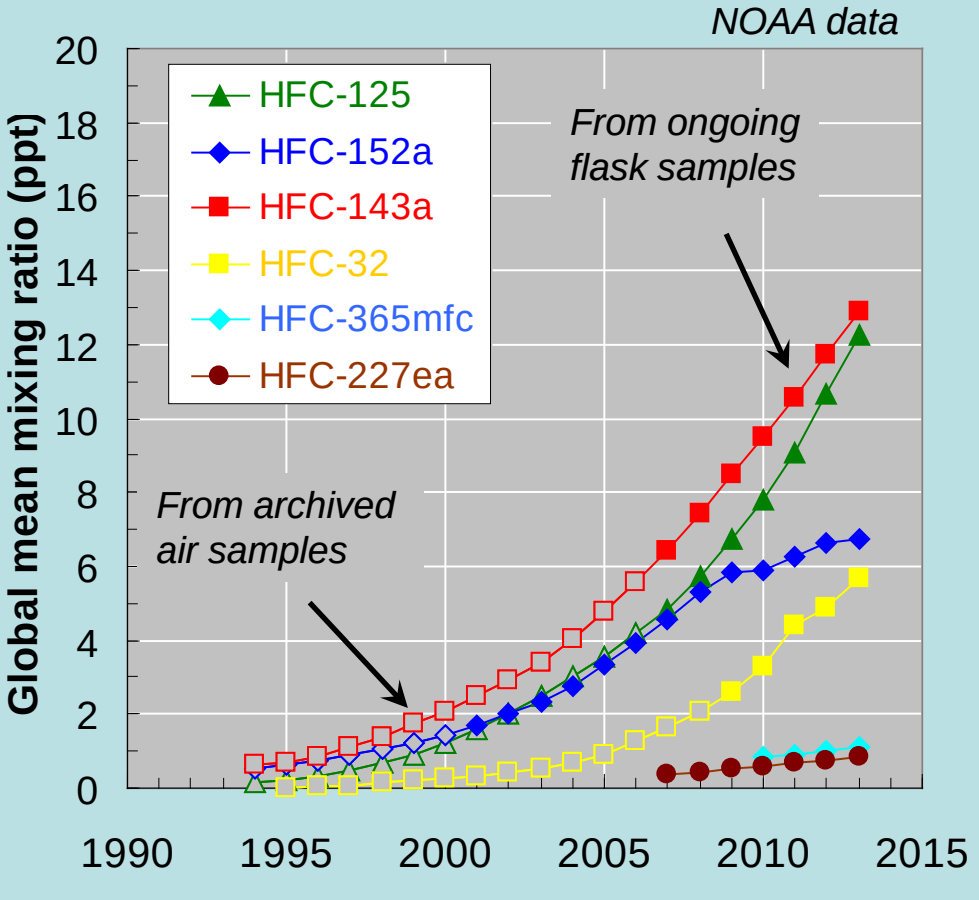
→Ozone and climate benefits…

→Potential implications for HFCs: Earlier transition to HFCs?

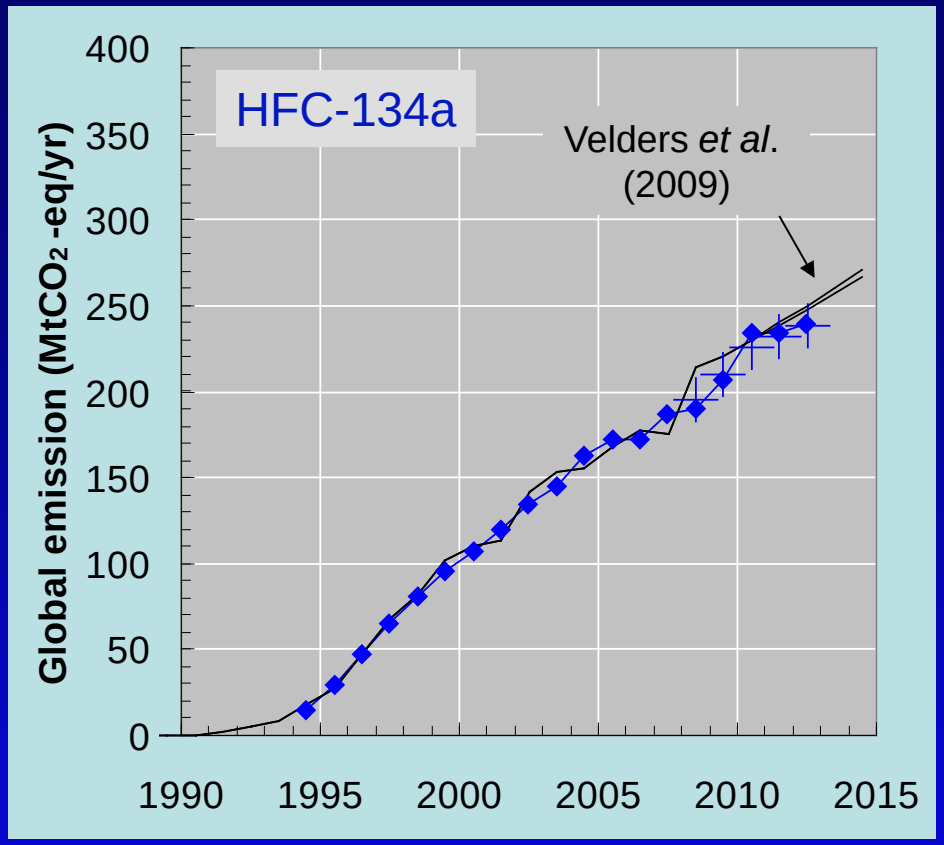
Global atmospheric changes for HFCs:

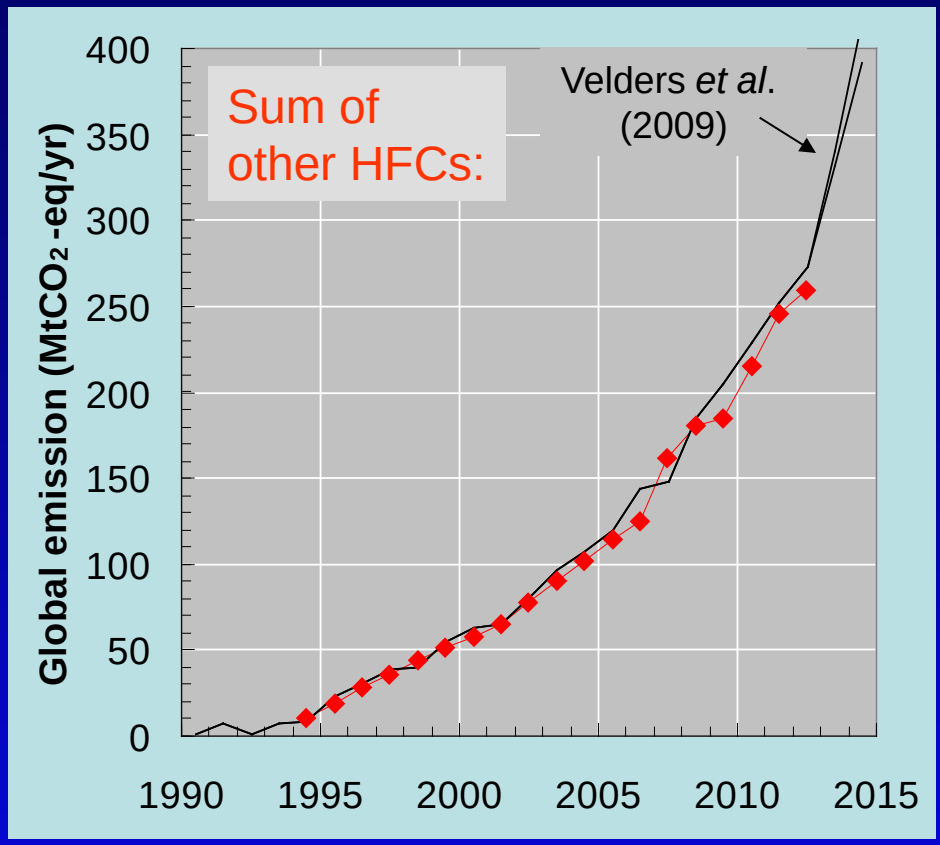


CFC-12 replacement



Global CO_2-equivalent emissions of HFCs:





* Global HFC emissions are increasing, consistent with Velders et al. projection—but will this increase accelerate after 2012?

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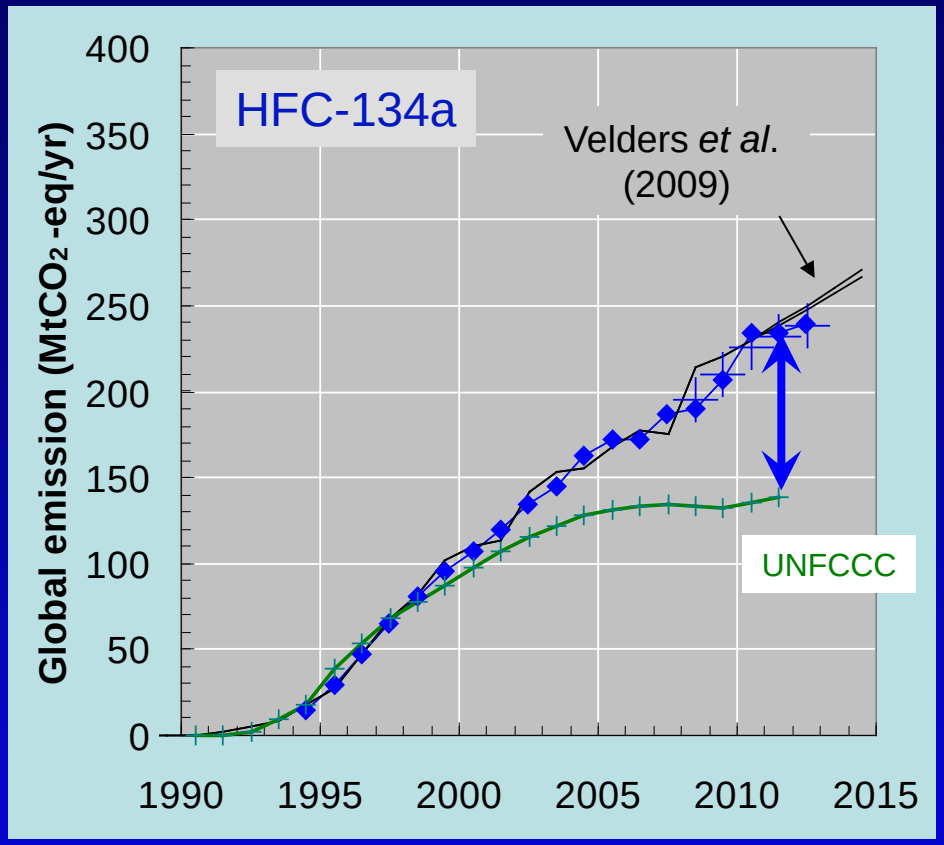
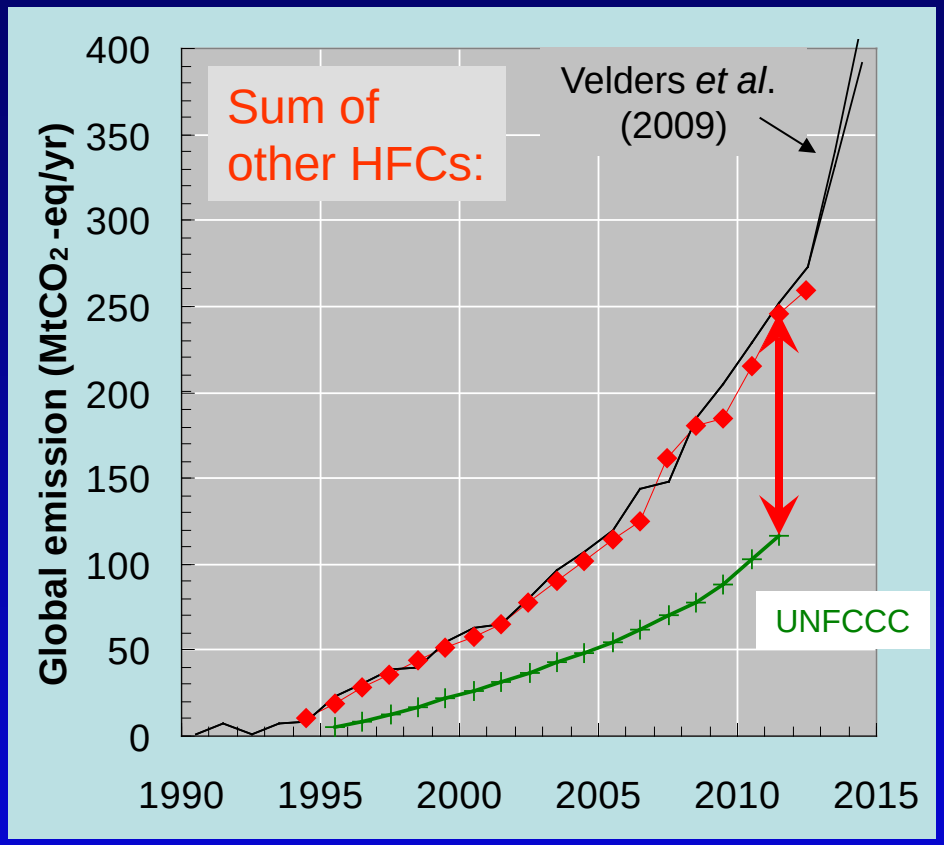




* Global HFC emissions are increasing, consistent with Velders et al. projection—but will this increase accelerate after 2012?

* 40-50% of global HFC-134a emissions are missing from UNFCCC compilations.

Either:

→Transition from ODSs to HFCs is well underway in developing countries

→ Large inaccuracies exist in UNFCCC reporting from developed countries

Conclusions:

For HCFCs:

Atmospheric increases have been slower overall since 2007 than projected.

HCFC-22 emissions have been constant since 2007,

…decreases in developed country emissions may be offsetting increases expected from developing countries.

Summed global HCFC emissions have not increased substantially since the 2007 Adjustments to the Montreal Protocol were agreed to,

…***and have likely reached their peak***.

For HFCs:

Velders *et al*. (2009) projections for HFC emissions are very good through 2012.

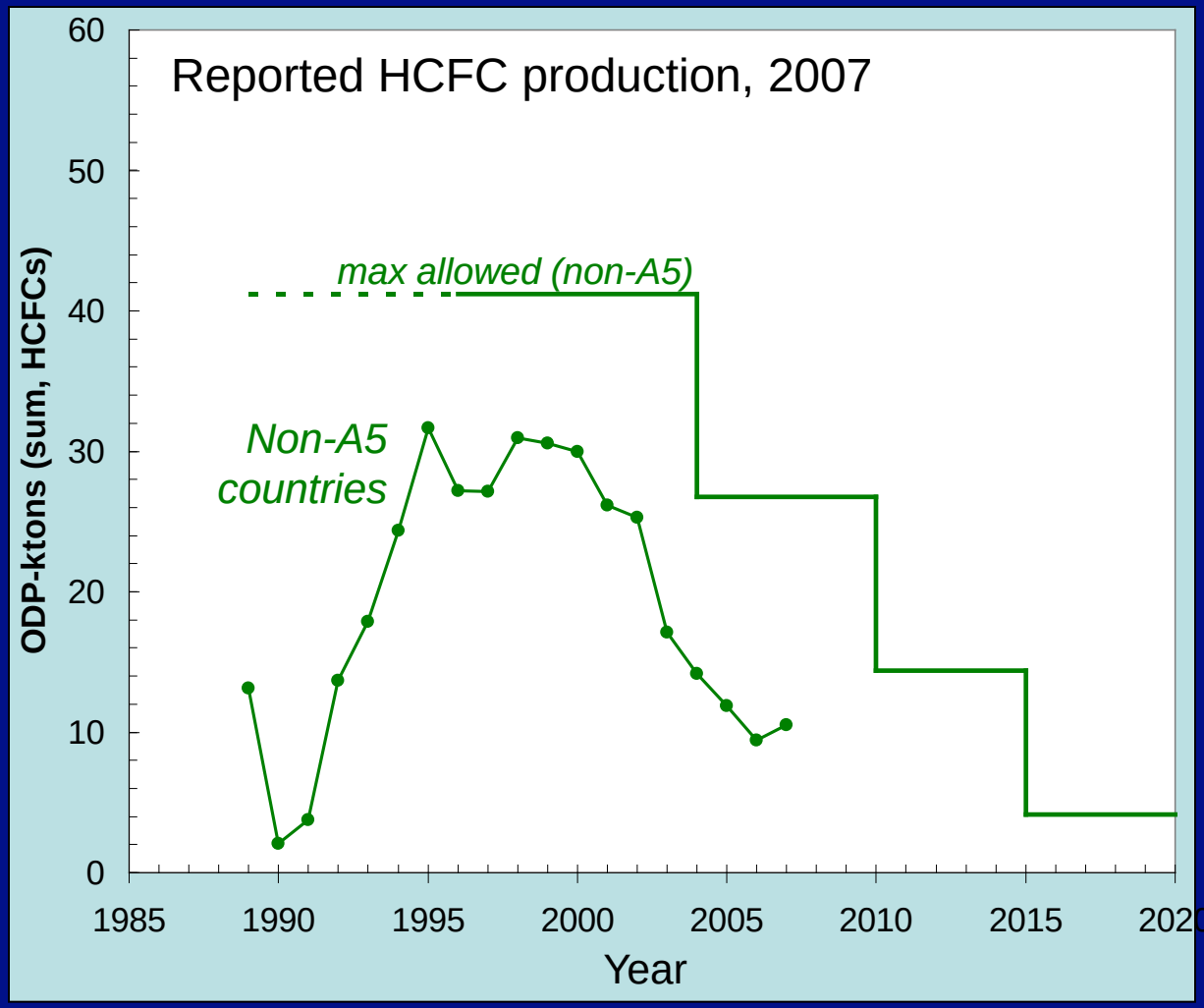
→*Reduced releases of HCFC have not caused larger than expected HFC emissions, though large increases are projected for the future…*

And:

Discrepancies with emissions reported to the UNFCCC may suggest that the transition from HCFCs to high-GWP HFCs is well underway in developing countries…

HCFC production in the Montreal Protocol:

...phased out in different countries with different schedules



As of 2007:

Developed countries (non-A5):
Decreasing, below max.

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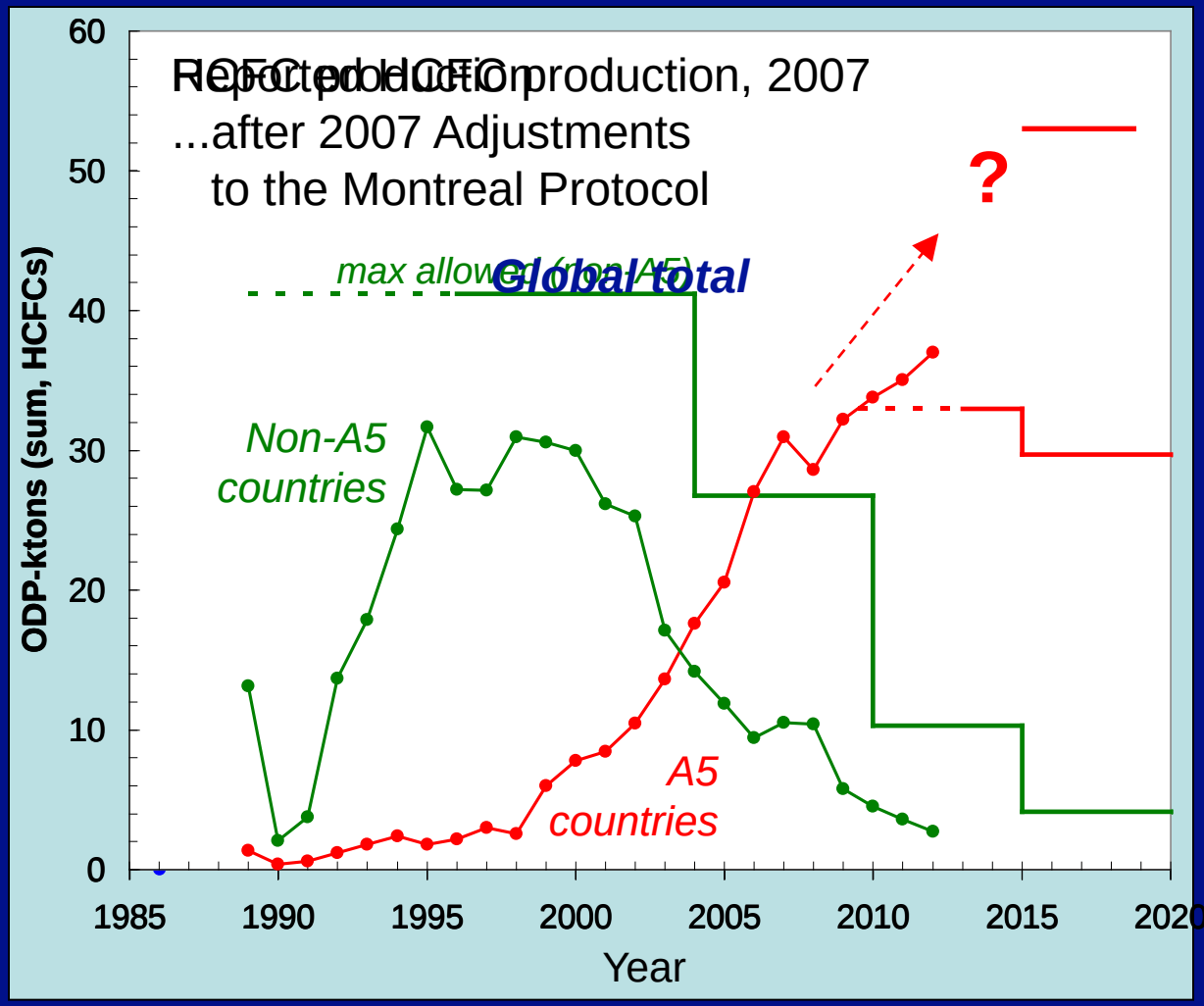

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Developing countries (A5):
Increasing rapidly,
no limit until 2015.

The 2007 MP Adjustments:

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* A5: Limited as of Jan 2013 based on 2009-2010 levels

Production since 2007:

Globally stable,

HCFC production in the Montreal Protocol:

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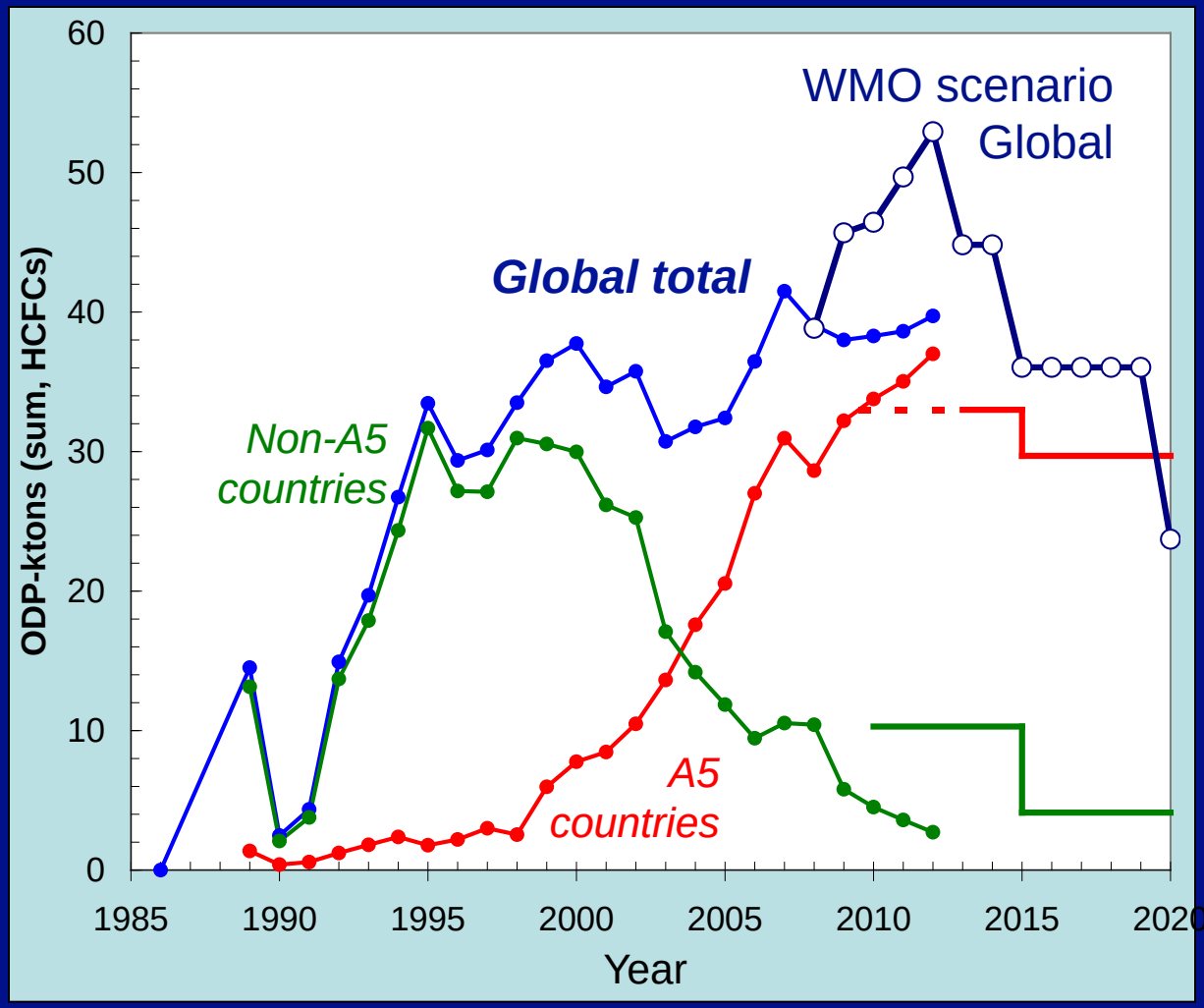

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Production since 2007:

Globally stable, though could have increased…

How about emissions?

→implications for HFCs?

Peak ODS production in late 1980s was ~1500 ODP-Kt