Trends in HFC emissions and updated projections

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Previous HFC projections: WMO assessment 2018

- Large projected increase HFC emissions in absence of regulations
- 2050 emissions: 4.0-5.3 GtCO$_2$-eq/yr

HFC contribution to surface warming: 0.3-0.5 °C in 2100

UNEP/WMO (2018)
Emissions from observations vs projections

Are recent HFC observations in agreement with projections?

- Emissions inferred from observed global average mixing ratios from NOAA and AGAGE

- Baseline HFC projection from Velders et al. (2015) and WMO(2018)
  - Business-as-usual
Inferred emissions HFC-143a much lower

- HFC-143a
  - Refrigeration (industrial & commercial)
  - 50% below projected level

- HFC-134a
  - Various uses
  - Good agreement with projection

**Use of HFCs in industrial/comm. refrigeration smaller than expected**
- In EU
- Consumption in China

**Scenarios with reduced HFC use in ICR**

Velders et al. (ACP, 2022)
Inferred emissions HFC-32, -125 lower

- **HFC-32**
  - Stationary AC
  - 20-25% below projection

- **HFC-125**
  - Stationary AC + Refrigeration
  - 30-40% below projection
  - Good agreement with limited use in refrigeration

➔ **Use of HFCs in industrial/comm. refrigeration smaller than expected**
  - Smaller growth in sector
  - Conversion away from HFCs

Velders et al. (ACP, 2022)
HFC consumption nonA5 countries

- Consumption derived from UNFCCC reported data
- Reduction in HFC-134a consumption
- Consumption HFC-143a stabilized
- HFC-143a more than halved in EU
- Stabilized in USA and Japan

Also (not shown here)
- Lower consumption in China than before

Velders et al. (ACP, 2022)
HFC-134a consumption nonA5 countries

- Large reduction in HFC-134a consumption in mobile AC use

Velders et al. (ACP, 2022)
Inferred CO$_2$-eq emissions below projections

- Total emissions seem to level off
- Emissions 20-30% below projections
- Annex 1 reported emissions constant since ~ 2014
- Reduced HFC prod/cons in refrigeration close agreement with inferred emissions

Velders et al. (ACP, 2022)
Updated scenarios

- NOAA and AGAGE observed mixing ratios 1990-2020
  ➔ Inferred global emissions of 10 HFCs

- NonA5: HFC data from UNFCCC reporting
  - Statistics: Newly manufactured, Operating systems, Decommissioning
  - Emissions from various stages
  ➔ Consumption 1990-2017 for 10 HFCs, 13 use sectors

- A5: New HFC consumption data
  - China, bottom-up data 1995-2017 from Li et al. (2019)
  - India, data for 2016 (Say et al., 2019)

- HCFC phaseout data from UNEP
- Policies in EU, USA, Japan
- Kigali amendment provisions

Scenario, as before:

HFC demand proportional to GDP and Population from IPCC Shared-Socioeconomic Scenarios
Updated HFC projections

- Baseline without HFC controls
- Current policies in EU, USA, Japan
- Current trends (from obs.)
- Kigali amendment
- Hypothetical zero production and emissions scenario

Velders et al. (ACP, 2022)
• Implementation of Kigali Amend.

• Assumed here: uniform reduction over all sectors
Figure 7: Temperature

- **Temperature contribution HFCs in 2100:**
  - From baseline: 0.28-0.44 °C
  - To current policy: 0.14-0.31 °C
  - To Kigali Am.: ~ 0.04 °C

- **Zero production in 2023:** <0.01 °C

Velders et al. (ACP, 2022)
Conclusions

HFC emissions inferred from observations less than business-as-usual projections

- Smaller HFC use for industrial/comm. refrigeration smaller than projected previously

Updated projections lower than before

Effect of Kigali Amendment similar as before

- Surface temperature reduction of 0.2-0.4 °C