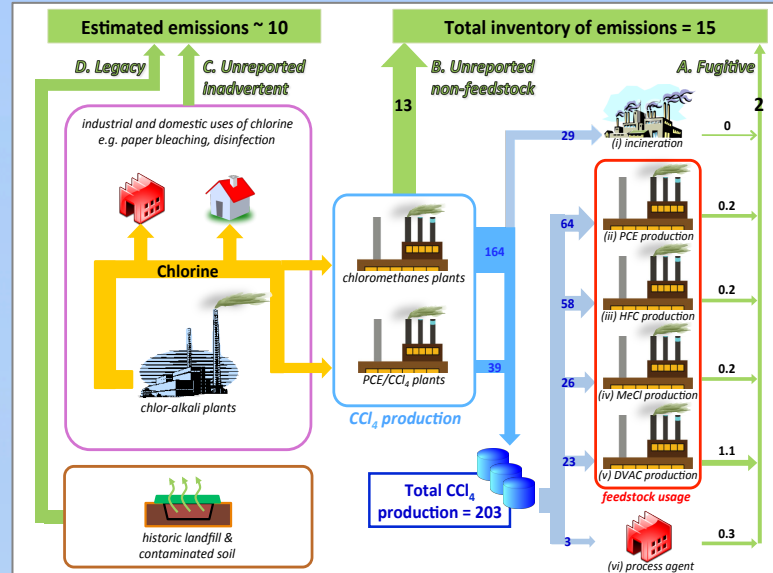


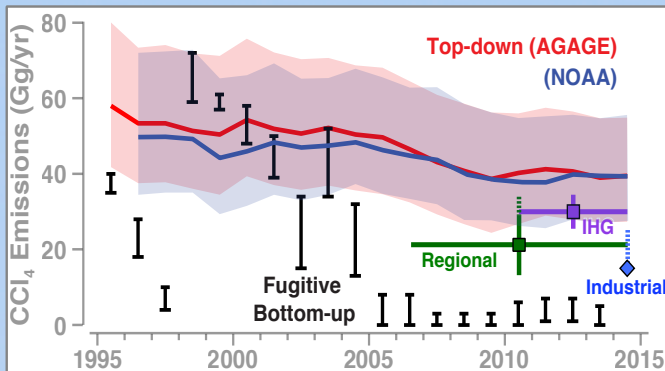
SPARC, 2016: SPARC Report on the Mystery of Carbon Tetrachloride. Q. Liang, P.A. Newman, S. Reimann (Eds.), SPARC Report No. 7, WCRP-13/2016. URL: www.sparc-climate.org/publications/sparc-reports/sparc-report-no7/

The “Solving the Mystery of Carbon Tetrachloride” workshop was held in Dübendorf, Switzerland, 4-6 October 2015. The workshop included participants from 16 different countries. Attendees included scientists, technologists, engineers, industry experts, and policymakers. The report was reviewed both internally, and by 9 independent referees.

- CCl_4 continues to decline in our atmosphere. However, in spite of the Montreal Protocol controls, there are large ongoing CCl_4 emissions into the atmosphere.
- Four emission pathways have been identified
 - Fugitive:** PCE, HFC, methyl chloride, DVAC production, and incineration and process agents (2 Gg yr^{-1})
 - Unreported non-feedstock:** chloromethanes plants and PCE plants (13 Gg yr^{-1})
 - Unreported inadvertent emissions:** chlor-alkali plants (unknown)
 - Legacy:** landfills and contaminated sites (C. & D combined pathways ~ 10 Gg yr^{-1})



Schematic of CCl_4 routes from pre- CCl_4 production of chlorine gas in chlor-alkali plants (left), production (middle), usage (right), and emissions of CCl_4 (top) (Gg yr^{-1}). Production and use of chlorine gas are shown in yellow, industry production in blue, usage in greyish blue, and CCl_4 emissions in green. UNEP report numbers are shown in blue. Estimates are courtesy of Dr. David Sherry (Nolan Sherry & Associates). Global legacy emissions are estimated based on results from Fraser et al. [2014].



Estimated annual emissions of CCl_4 , based on measurements of its atmospheric abundance (red AGAGE, blue NOAA). Top-down uncertainties are $\pm 1\sigma$. Revised emission estimates from UNEP reports (black). Industrial emissions (blue diamond), with the blue dotted line showing legacy emissions. Emissions from the observed interhemispheric gradient are in purple. Sum of regional emissions is in green, with dotted line showing an estimate of regional emissions that have not been measured.

- UNEP reports are used to estimate fugitive bottom-up emissions. **However, this fugitive only method is not adequate for estimating total global CCl_4 emissions.**
- The new industrial bottom-up emissions estimate includes emissions from chloromethanes plants (13 Gg yr^{-1}) and feedstock fugitive emissions (2 Gg yr^{-1}). When combined with legacy emissions and unreported inadvertent emissions (~ 10 Gg yr^{-1}), this is **20 ± 5 Gg yr^{-1} .**
- The four regional emissions estimates sum to **21 ± 7.5 Gg yr^{-1} ,** but this is not a complete global accounting. These regional top-down emissions estimates also show that most CCl_4 emissions originate from chemical industrial regions – not major population centres.
- CCl_4 is destroyed in the stratosphere, oceans, and soils. The total lifetime estimate has been increased from 26 to 33 years, leading to global top-down emissions of **40 (25-55) Gg yr^{-1} .**
- Emissions can be calculated from the interhemispheric gradient, yielding **30 (25-35) Gg yr^{-1} .**

These new emissions estimates reconcile the CCl_4 budget discrepancy when considered at the edges of their uncertainties, although the new bottom-up value (20 ± 5 Gg yr^{-1}) is still less than the aggregated top-down values (35 ± 16 Gg yr^{-1}).