International Halon Replacement Update Decision XXIX/8

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Decision XXIX/8

- Decision XXIX/8 on the future availability of halons and their alternatives, requested the Technology and Economic Assessment Panel (TEAP), through its Halons Technical Options Committee (HTOC) to:
  - Continue to liaise with the International Civil Aviation Organization (ICAO) on the development and implementation of alternatives to halons, and their rate of adoption by civil aviation, *and to report thereon in its 2018 progress report;*
  - Explore the possibility of forming a joint working group with ICAO to develop and carry out a study to determine the current and projected future quantities of halons installed in civil aviation fire protection systems, associated uses and releases of halons from those systems and any potential courses of action that civil aviation could take to reduce those uses and releases;
  - Submit a report on the work of the joint working group before the 30th Meeting of the Parties and the 40th ICAO Assembly for consideration and potential further action;
- TEAP / HTOC participants of the ICAO informal working group and authors of the report
  - Dan Verdonik, HTOC co-Chair, Adam Chattaway, HTOC co-Chair
  - Tom Cortina, HTOC Consulting Expert, Bella Maranion, TEAP co-Chair (and former HTOC Member)
- Thanks to USEPA and its contractor ICF International for supporting analyses

ICAO Informal Working Group

- After a March 2018 planning meeting, ICAO agreed to form an informal working group to provide information on:
  - current and projected future quantities of halon installed in civil aviation
  - associated uses and releases of halon from those systems
  - potential courses of action to minimize unnecessary halon emissions
- The informal working group consists of representatives from
  - airframe manufacturers Boeing, Airbus and Bombardier
  - civil aviation fire protection cylinder manufacturers Meggitt and United Technologies
  - civil aviation non-governmental organizations the International Air Transport Association (IATA) and the International Coordinating Council of Aerospace Industry Associations (ICC AIA)
  - the ICAO secretariat, HTOC cochairs (Dan Verdonik and Adam Chattaway) and Consulting Expert (Tom Cortina), and TEAP co-chair (Bella Maranion)
- Prepared a survey that ICAO sent out officially as an ICAO State letter
- It was anticipated that the survey would provide a more accurate estimate of annual halon 1301 emissions from civil aviation

Questionnaire Development

- Questionnaire designed to be short and simple
  - contact information and confirmation they perform halon 1301 servicing of civil aviation bottles
  - two questions to determine the amount of halon needed to be replaced in the bottles they received for servicing (i.e., the amount that was emitted from the bottles in service)
  - four additional voluntary questions to get a sense of the halon 1301 market and availability
- Informal working group members from servicing companies thought it likely that most, if not all, companies would track or log:
  - the amount of halon recovered from the bottles they received (this would incur a cost to the company to get recycled/reclaimed), and
  - the amount of recycled/reclaimed halon put back into the same bottles (that would be charged to the customer of the bottle)
- National servicing companies' contact information provided to States

Questionnaire Results and Next Steps

- 53 surveys were received, 33 confirmed servicing aviation halon 1301 bottles
  - Only 21 provided data
  - Only 10 provided data on the two main questions intended to determine emissions
- The difference between the amount recovered versus the amount filled:
  - Ranged from 4% to 50%
  - Averaged 14%
  - Too limited of a data set to determine a more accurate emission rate
  - Provided additional anecdotal information that civil aviation emissions could be significantly higher than the 2-3% annual average overall emission rate used by the HTOC
  - Other anecdotal information available to the HTOC supports a higher annual emission rate
- The Working Group recognized that a number of major service companies did not respond
  - Some only provided data from one facility and not company wide
  - Additional companies were identified in the survey
- ICAO is following up with these companies to try to get additional data

Global Halon 1301 for Civil Aviation Use

- HTOC estimates 37,750 metric tonnes of halon 1301 available globally at the end of 2018
  - Approximately 16,250 metric tonnes maintained by Japan are not expected to be available to support other continuing uses of halon outside of Japan
  - Leaves at most 21,500 metric tonnes potentially available for civil aviation, however
    - Military applications are estimated to have 4,500 metric tonnes in the installed base and reserves
    - Oil and gas facilities are estimated to have 1,500 metric tonnes
    - Nuclear facilities are estimated to have 200 metric tonnes
    - Global aviation bank (100 metric tonnes) and installed base are estimated to be 2,800 metric tonnes
    - Marine (non-military) applications are estimated to be 1,500 metric tonnes (30-yr lifetime) and is projected to run out in approximately 2023
    - Electronics facilities, such as computer and communications rooms, are estimated at 11,000 metric tonnes
  - Military, oil and gas facilities, and nuclear facilities amounts are assumed not to be available
  - Halon currently installed in aviation applications is already in use and not available for future new use
- This leaves about 12,500 metric tonnes of halon 1301 that could become available to support civil aviation if all of it went only to civil aviation – likely not a good assumption
- Update analysis originally performed for Decision XXVI/7

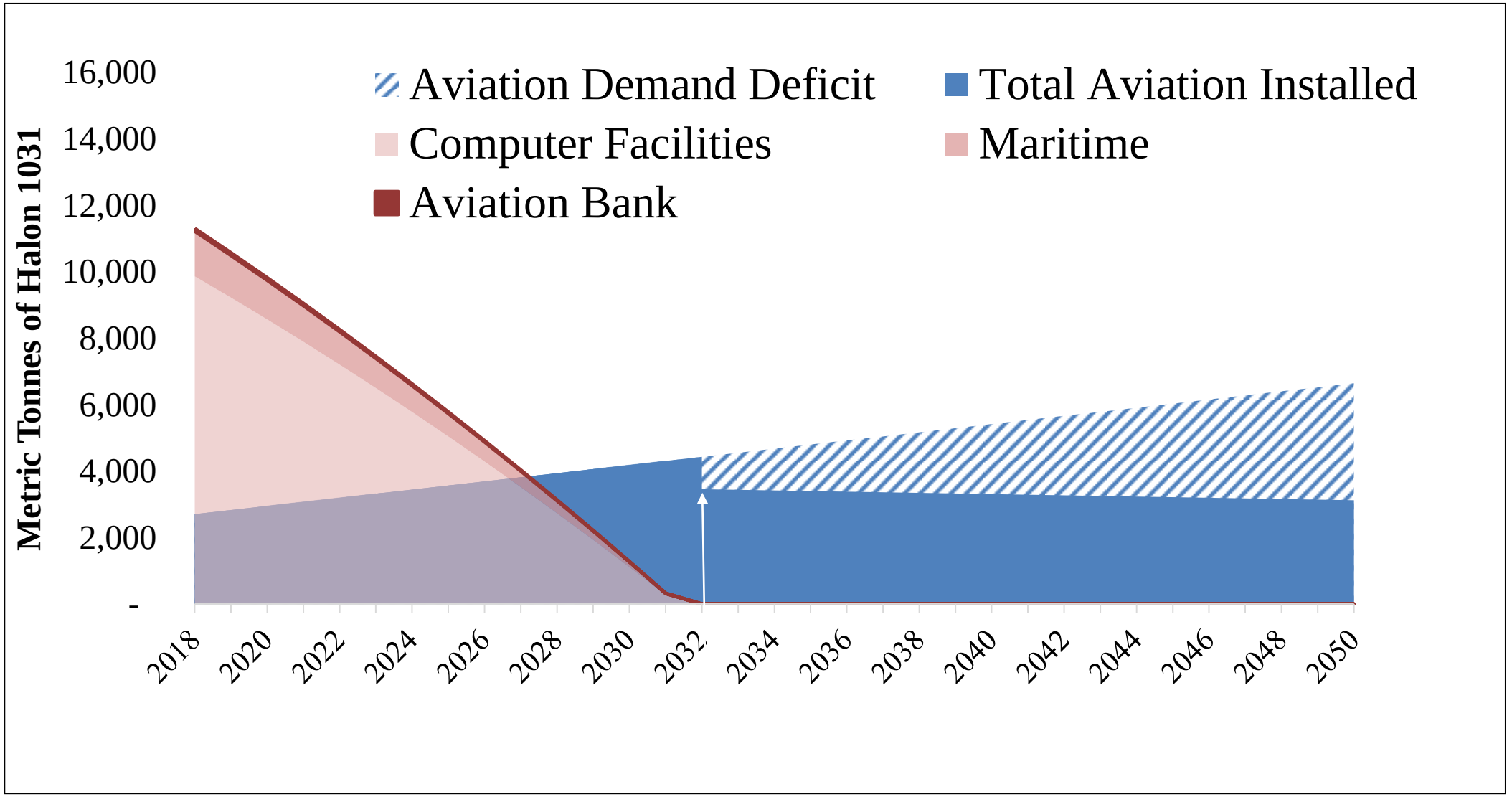
Modeling Use, Emissions and Run-out Date

- Two assumed amounts of available halon (12,500 +/- 10%) and four emissions scenarios - a total of eight total scenarios

	Total Available Worldwide Supply in 2018	Annual Emission Rate (Aviation)	Annual Emission Rate (non-Aviation)	Global Overall Emission Rate	Year Available Supply Runs Out
1	11,500	2.3 – 2.8%	0.1 – 3%	1.6%	2048
2	11,500	7.6%	0.1 – 3%	1.9%	2038
3	11,500	5.0%	1 – 5%	2.3%	2040
4	11,500	15.0%	1 – 5%	3.9%	2032
5	13,750	2.3 – 2.8%	0.1 – 3%	1.6%	2054
6	13,750	7.6%	0.1 – 3%	2.0%	2042
7	13,750	5.0%	1 – 5%	2.3%	2045
8	13,750	15.0%	1 – 5%	3.8%	2034

- HTOC model assumes an average 2.5 % emission rate
- Atmospheric concentrations derived emissions are closer to 4%, hence scenario 4 is plausible

Scenario 4 (15% aviation emission rate, 11,500 metric tonnes globally available end 2018



Summary and Conclusions

- The global amount of halon 1301 used in this analysis is based on the HTOC model
- Atmospheric measurement derived emissions are higher than HTOC estimates
  - While, all within the uncertainty range, these estimated emissions are much higher than those of HTOC
  - Banks could be much smaller (assuming the same amount of production) by as much as 9,000 metric tonnes
- The civil aviation emission rate is still uncertain but is a major driving force in overall emissions and hence the remaining bank. A 15% emission rate would deplete the bank in the early 2030s
- Results confirm that the civil aviation emission rate needs to be better understood
- HTOC will continue to work with ICAO
  - Refine emission estimates as much as possible from the current survey
  - Develop a Working Paper for the upcoming General Assembly in Sep/Oct 2019
    - Develop actions for ICAO to take to obtain data for estimating emissions
    - Recommend initiatives to reduce emissions
- Based on the run-out dates of 2032 – 2054 and aircraft lifetimes of 40 years, it is now highly likely that civil aviation is producing aircraft that cannot be sustained with the available supplies of halon 1301