



## UNEXPECTED CFC-11 EMISSIONS

BRIEFING TO THE 43RD MEETING OF THE OPEN-ENDED WORKING GROUP OF THE PARTIES  
TO THE MONTREAL PROTOCOL (OEWG 43)

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### EXECUTIVE SUMMARY

As we approach three years since scientists first reported unexpected large-scale CFC-11 emissions, this report examines the current state of knowledge and pinpoints remaining critical gaps in data and understanding. EIA investigations uncovered widespread use of CFC-11 in China's polyurethane (PU) foam sector, with over 85% of the companies surveyed confirming use of CFC-11 in their operations. Data from Chinese enforcement efforts so far has not matched the extent of EIA findings or explained the scale of emissions. However, several nation-wide and systemic measures have been put in place by the Government of China to improve monitoring and enforcement efforts. Two Nature papers published in early 2021 suggest that CFC-11 emissions are back on a downward trajectory, potentially avoiding substantial delays in the recovery of the ozone layer.

On the other hand, new scientific findings suggest the unaccounted emissions might be even larger than estimated in 2018; further expanding the gap in what has been verified about the illegal production and use of CFC-11, potential related emissions of CTC and CFC-12, and the size of the

remaining bank of CFC-11 created by the illegal activity. This underlines the need for Parties to the Montreal Protocol and its institutions to continue to make all efforts to address data gaps and enhance global understanding of the drivers of illegal CFC-11 production and use and the resulting emissions. Such understanding is necessary in order to comprehensively respond and ensure sustained implementation of Montreal Protocol controls.

Recommendations discussed include enhancing understanding of what happened based on enforcement efforts in China, as well as new estimates of the CFC-11 bank. The scale of the unaccounted emissions and other higher than expected emissions of controlled chemicals (e.g. HFC-23, CFC-12) compel a very serious look at the current monitoring, reporting, verification (MRV) requirements and procedures of the Montreal Protocol. The Montreal Protocol must undertake a comprehensive review of its monitoring and enforcement regime to ensure it is effective in implementing and sustaining implementation of existing controls, combating the illegal trade in ODS and preparing for new controls on HFCs.

## EIA INVESTIGATIVE FINDINGS

Following initial findings of unexplained atmospheric emissions of CFC-11, EIA investigated the use of the banned ozone-depleting substance (ODS) in China in the spring of 2018. In our report, [Blowing It: Illegal Production and Use of Banned CFC-11 in China's Foam Blowing Industry](#), EIA uncovered widespread use of CFC-11 in China's PU foam sector, with over 85% of the companies surveyed confirming use of CFC-11 in their operations. Companies admitted that CFC-11 was the predominant blowing agent in their foam production, accounting for 70-100% of their total product.

In November 2018, EIA shared additional findings and identified unanswered questions from the initial investigation in [Tip of the Iceberg: Implications for Illegal CFC Production and Use](#). Independent laboratory testing confirmed the presence of CFC-11 in multiple foam samples collected in China during EIA's investigation. Additionally, EIA presented concerns about knowledge gaps, including questions over emissions of CFC-12, unaccounted CTC emissions (a feedstock chemical for CFC-11) and presented an estimate for the potential size of the CFC-11 bank created by the illegal production and use. EIA called for a comprehensive review of the Montreal Protocol monitoring and enforcement mechanisms, and urged Parties to strengthen enforcement efforts at the domestic level.

At the 30th Meeting of the Parties to the Montreal Protocol (MOP30), the scientific findings alongside EIA's revelations prompted a strong response from the Parties, with a decision agreed on immediate steps to be taken to address CFC-11 emissions.<sup>1</sup>

## RELEVANT SCIENTIFIC FINDINGS

Atmospheric measurements demonstrate increased emissions of CFC-11 starting in 2013. The emissions were estimated to be ~13 Gigagrams (Gg), or 13,000 tonnes, per year higher over the 2014-2016 period, compared with 2002-12. By 2019, emissions of CFC-11 leveled off to pre-2013 levels. Over the 2012-2019 period, cumulative unexpected emissions are estimated to be 120-440

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<sup>1</sup> Decision XXX/3. Unexpected Emissions of Trichlorofluoromethane (CFC-11).

Gg.<sup>2</sup> Following is a summary of pertinent scientific findings related to the unexplained CFC-11 emissions, several of which are also covered in the 2021 Scientific Assessment Panel report.

Scientists have reported that a majority of the emissions originated from Eastern Mainland China, which accounted for 60% ± 40% of the global CFC-11 increase.<sup>3</sup> Scientists have also been clear that, despite uncertainties over the size of the historic CFC-11 bank, the increase in CFC-11 was from new production and use and did not match the estimated emissions from banks.

According to the SAP 2021 report, recovery of the stratospheric ozone hole will not be significantly delayed by the unexpected emissions.<sup>4</sup> This assumes, however, future compliance with the ban on CFC-11. If emissions continued unabated at 2018 levels, recovery of the ozone hole could be delayed by up to 18 years.<sup>5</sup>

New studies published in 2020 quantified the contribution to CFC emissions of current CFC-11, CFC-12 and CFC-113 banks. The authors concluded that CFC-11 and CFC-12 banks are larger than previously estimated and that the CFC-11 bank is around 140 Gg larger due to the illegal production and use of CFC-11 after 2012. The study noted that CFC-113 emissions exceed what would be expected from the banks and allowed production as a feedstock chemical, and could be associated with illegal production of CFC-11.<sup>6</sup>

If left unrecovered, the CFC banks could delay ozone recovery by 6 years and contribute 9 billion tonnes CO<sub>2</sub>e between 2020 and 2100.<sup>7</sup>

Similar uncertainty exists in the global understanding of carbon tetrachloride (CTC). CTC is a common feedstock chemical used in the production of CFCs. Between 2000-2009 emissions of CTC fell steadily, yet in the next decade, after CTC was globally phased-out in 2010, emissions did not decline as much.<sup>8</sup> Correlation was found between rising CFC-11 and the slow in CTC emissions reductions.<sup>9</sup> This is in part because CTC continues to be used in “non-dispersive uses”, as chemical feedstock and process agent, which potentially contributed to the rise in CTC emissions seen this past

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<sup>2</sup> Montzka, S. A., Dutton, G. S., Yu, P., Ray, E., Portmann, R. W., Daniel, J. S., ... & Elkins, J. W. (2018). An unexpected and persistent increase in global emissions of ozone-depleting CFC-11. *Nature*, 557(7705), 413-417; Montzka, S. A., Dutton, G. S., Portmann, R. W., Chipperfield, M. P., Davis, S., Feng, W., ... & Theodoridi, C. (2021). A decline in global CFC-11 emissions during 2018– 2019. *Nature*, 590(7846), 428-432; The Scientific Assessment Panel (SAP) of the Montreal Protocol on Substances that Deplete the Ozone Layer. (2021). Report on the Unexpected Emissions of CFC-11. World Meteorological Organization.

<sup>3</sup> Rigby, M., Park, S., Saito, T., Western, L. M., Redington, A. L., Fang, X., ... & Young, D. (2019). Increase in CFC-11 emissions from eastern China based on atmospheric observations. *Nature*, 569(7757), 546-550.

<sup>4</sup> SAP, 2021.

<sup>5</sup> Dhomse, S. S., Feng, W., Montzka, S. A., Hossaini, R., Keeble, J., Pyle, J. A., ... & Chipperfield, M. P. (2019). Delay in recovery of the Antarctic ozone hole from unexpected CFC-11 emissions. *Nature communications*, 10(1), 1-12.

<sup>6</sup> Lickley, M., Solomon, S., Fletcher, S., Velders, G. J., Daniel, J., Rigby, M., ... & Stone, K. (2020). Quantifying contributions of chlorofluorocarbon banks to emissions and impacts on the ozone layer and climate. *Nature communications*, 11(1), 1-11.

<sup>7</sup>Ibid.

<sup>8</sup> SAP, 2021.

<sup>9</sup> Lunt, M. F., Park, S., Li, S., Henne, S., Manning, A. J., Ganesan, A. L., ... & Rigby, M. (2018). Continued emissions of the ozone-depleting substance carbon tetrachloride from eastern Asia. *Geophysical research letters*, 45(20), 11-423.

decade. However, scientific understanding of the elevated levels of CTC is still unfolding. Scientists recorded a gap in observed and reported emissions of CTC, and found fugitive emissions of CTC from feedstock use of about 15 Gg a year.<sup>10</sup> Without controls on feedstock use, scientists note CTC and other feedstock leakage as potential “emissions slipping through the treaty”.<sup>11</sup>

In February 2021, two papers reported a global and regional decline in atmospheric CFC-11, demonstrating that CFC-11 is back on a downward trajectory.<sup>12</sup> Scientists attributed 60% of this decline in emissions to China, which aligns with previous estimates that China was responsible for 60% ± 40% of the emission increase.<sup>13</sup> The swift impact on atmospheric emissions is a testament to Montreal Protocol global community, including the scientists and nation-wide enforcement efforts undertaken by China. However, much work remains to address continuing emissions from ODS banks, feedstocks and illegal production and use.

In terms of future scientific assessment, concerns remain about emissions from the CFC banks, as well as atmospheric lifetimes of CFCs and their implications for accurately estimating the scale of emissions. Current models of CFCs and their lifetimes do not assess the effect of oceanic processes, which if considered could significantly reduce CFC atmospheric lifetimes.<sup>14</sup> Other findings concluded that the lifetimes of CFC-11, CFC-12, and CFC-113 are likely shorter than previous estimates predicted, meaning the increase in direct emissions seen this past decade was actually larger than scientific findings suggest.<sup>15</sup> The authors estimate new unexpected emissions during 2014-16 were 23.2, 18.3 and 7.8Gg/yr for CFC-11, 12 and 113 respectively. The difference between previous CFC-11 estimates and these findings suggests an additional 10 Gg/yr of unexpected CFC-11 emissions between 2014-2016.<sup>16</sup>

## UPDATED TEAP FINDINGS

In response to the unexpected CFC-11 emissions, Parties requested the Technology and Economic Assessment Panel (TEAP) to provide them with relevant information on potential sources of emissions of CFC-11 and related controlled substances. In response, TEAP formed a temporary subsidiary body, in the form of a Task Force, which combines expertise from TEAP and its Technical Options Committees (TOCs), and also outside expertise. Based on modelling of CFC-11 production, usage, emissions and comparison against atmospheric-derived emissions, TEAP concluded that it is

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<sup>10</sup> SAP, 2021; Sherry, D., McCulloch, A., Liang, Q., Reimann, S., & Newman, P. A. (2018). Current sources of carbon tetrachloride (CCl<sub>4</sub>) in our atmosphere. *Environmental Research Letters*, 13(2), 024004.

<sup>11</sup> Solomon, S., Alcamo, J., & Ravishankara, A. R. (2020). Unfinished business after five decades of ozone-layer science and policy. *Nature Communications*, 11(1), 1-4.

<sup>12</sup> Montzka, S. A., Dutton, G. S., Portmann, R. W., Chipperfield, M. P., Davis, S., Feng, W., ... & Theodoridi, C. (2021). A decline in global CFC-11 emissions during 2018– 2019. *Nature*, 590(7846), 428-432.

<sup>13</sup> Park, S., Western, L. M., Saito, T., Redington, A. L., Henne, S., Fang, X., ... & Rigby, M. (2021). A decline in emissions of CFC-11 and related chemicals from eastern China. *Nature*, 590(7846), 433-437; Rigby, M., Park, S., Saito, T., Western, L. M., Redington, A. L., Fang, X., ... & Young, D. (2019). Increase in CFC-11 emissions from eastern China based on atmospheric observations. *Nature*, 569(7757), 546-550.

<sup>14</sup> Wang, P., Scott, J. R., Solomon, S., Marshall, J., Babbin, A. R., Lickley, M., ... & Prinn, R. G. (2021). On the effects of the ocean on atmospheric CFC-11 lifetimes and emissions. *Proceedings of the National Academy of Sciences*, 118(12).

<sup>15</sup> Lickley, M., Fletcher, S., Rigby, M., & Solomon, S. (2021). Joint inference of CFC lifetimes and banks suggests previously unidentified emissions. *Nature communications*, 12(1), 1-10.

<sup>16</sup> Ibid.

unlikely that past production and historic usage can account for the unexpected CFC-11 emissions, including from existing foam banks. Based on its assessment, the Task Force also concluded that the production of certain foam products using CFC-11 was a potential source of the sudden and increased emissions of CFC-11, concluding it,

*“is likely that there has been a resumption of newly produced CFC-11 usage in closed-cell foams. It seems unlikely that the unexpected emissions have resulted from the traditional handling of foams at end-of-life alone unless there has been a significant change in those processes from appliances and construction for a very large volume of foams. This has been further validated in the final report by more closely examining the expected timing of increased emissions associated with the dismantling of foams.”*

The TEAP Task Force 2019 findings reinforce the need to continue to explore PU foam manufacturing as an important potential source of the unexpected CFC-11 emissions. Further validation of CFC-11 emissions rates during: production of the gas; transport for use; production of polyol systems; production and application of the different types of foam; shredding of foams before landfills; and during end-of-life in landfills is critical in determining the magnitude of this issue and prioritising action. A thorough analysis of each of these aspects is required to refine accuracy of the emissions rates that will in turn inform a better understanding of the scale of the issue on the ground. EIA agrees with the areas for further assessment outlined by the Task Force in Chapter 7 of the September 2019 report and recommends additional efforts be undertaken.

Parties requested an additional TEAP report in 2021 to update previous information and undertake additional specific analysis on geographic distribution and disposition of CFC-11 banks, linkages with production of anhydrous hydrogen fluoride and CTC, and opportunities and methods to recover CFC-11 from products. The draft TEAP report confirms earlier findings of the Task Force that the difference between inventory-based models and unexpected atmospheric emissions cannot be explained by existing banks alone.

The new draft report concludes that unreported CFC-11 production was already occurring during the 2007-12 period. This is necessary to explain the difference between inventory-based expected emissions and derived CFC-11 emissions during this earlier period. TEAP estimates unreported CFC-11 production to be 10-40 kilotonnes per year between 2007-12, 40-70 kilotonnes per year between 2013-18 and 15-40 kilotonnes of new production (or CFC-11 use from previous production) for 2019. The estimated cumulative total of unreported CFC-11 production is between 320 to 700 kilotonnes during 2007-2019. It estimates that, assuming usage in closed-cell foam production, this cumulative unreported CFC-11 production would lead to an increase in the magnitude of the CFC-11 bank of 266-333 kilotonnes by the end of 2019, equivalent to about 1.4 GtCO<sub>2</sub>e.

TEAP estimates that the total active CFC-11 bank in 2021, including foams, refrigerants and storage, is 800 ± 50 kilotonnes, or 3.8 Gt CO<sub>2</sub>e, although it is unclear whether this includes the newly created bank of CFC-11 due to recent illegal production and use. The report describes the feasibility of recovery and destruction of CFC-11 banks at end of life, which are characterized as being limited to active foam banks and centrifugal chillers, noting that foam recovery and destruction has been mandated in certain countries for insulating and appliance foams. The majority of the remaining active CFC-11 foam bank remains in North America and Europe, presumably other than the additional bank that was created by illegal production and use during the 2007-19 period. TEAP concludes that due to the difficulty of isolating ODS from non-ODS banks, programs targeting

recovery and destruction of both ODS and HFCs from foams would have the greatest success due to economies of scale and overall benefit.

Further information on the supply chain of pre-blended polyols will also be critical to understanding and addressing this issue. As reported by TEAP, Multilateral Fund Secretariat (MLFS) data from both Article 5 and non-Article 5 Parties indicates that up to 7,500 tonnes per year fluorocarbon blowing agent was incorporated into foam systems and/or imported. Given the volume of trade in polyols from China, there is a clear possibility that pre-blended polyols containing CFC-11 have been imported by other Montreal Protocol Parties. It is also vital to further examine the potential unregulated sources of CTC emissions with a view to increasing the understanding of those emissions and their potential linkages to unaccounted CFC-11 emissions.

## INFORMATION ON CHINA'S DOMESTIC RESPONSE

### **Inspections and Findings**

China has reported the detection of three confirmed CFC-11 production sites, which were demolished by authorities.<sup>17</sup> A total of just 43 tonnes of CFC-11 were seized from these sites. In July 2018, two “underground” factories producing CFC-11 illegally were demolished. One site in Langtou Town, Liaoning Province saw 145 tonnes of CTC and two sets of CFC-11 production equipment seized. At the other site in Houlu Village, Henan, 32.6 tonnes of CTC and 29.9 tonnes of CFC-11 were seized. In May 2019 another illegal CFC-11 production site was destroyed in Jicheng Town, Henan and 70 tonnes of CTC and 13 tonnes of CFC-11 found. The total production capacity of these three facilities was not reported.

A total of 42 enterprises were found to be using CFC-11. Chinese authorities conducted inspections of 1,172 enterprises from August to October 2018 including system houses and foam manufacturers, which identified 6 enterprises out of 392 that were tested using portable detectors to be using CFC-11. The enterprises were fined and products confiscated and destroyed. Subsequent efforts in 2019 to conduct additional inspections of 656 enterprises and tests at 322 enterprises yielded an additional 37 enterprises that tested positive for containing CFC-11. No information was reported on specific test results, quantities of CFC-11 detected in products seized, or estimated illegal use and emissions that could be attributed to the relevant enterprises.

### **Legal Reforms and Strengthened Enforcement**

China's efforts to improve monitoring and enforcement against illegal production and use have focused on legal reforms to strengthen punitive measures and deterrence, increasing law enforcement capacity, monitoring of raw materials and feedstocks, and launching an atmospheric monitoring network.

China proposed a revision of the Regulation on the Administration of Ozone Depleting Substances to further strengthen lifecycle regulations.<sup>18</sup> The proposed revision to the regulation codified the

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<sup>17</sup> See: Report of China on progress made in the monitoring and management system of ozone-depleting substances <https://ozone.unep.org/system/files/documents/MOP-31-INF-9E.pdf>

<sup>18</sup> Ministry of Ecology and Environment, Notice on Public Solicitation of "Regulations on the Management of Ozone Depleting Substances and Hydrofluorocarbons (Revised Draft for Solicitation of Comments), May 2020, at [http://www.mee.gov.cn/xxgk2018/xxgk/xxgk06/202005/t20200521\\_780130.html](http://www.mee.gov.cn/xxgk2018/xxgk/xxgk06/202005/t20200521_780130.html)

monitoring and enforcement response to CFC-11 in addition to incorporating the HFC phase-down. The proposed revision includes increased penalties for illegal production, consumption and use, inclusion of raw materials and co-products in required reporting and control measures and a platform to encourage citizen investigation and reporting on violations.

### **Law Enforcement Capacity**

China reported undertaking a number of activities aimed at increasing provincial and local level enforcement and testing capabilities.<sup>19</sup> The Ministry of Ecology and Environment (MEE) provided most provinces with 30 portable detectors by September 2019, and 20 more were to be allocated by end of 2019 to ensure all provinces had the capability to rapidly detect illegal use. Six testing laboratories were built, located in Beijing, Guangdong, Zhejiang, Shandong and Chongqing and two more being built in Hebei and Henan provinces. MEE also developed two laboratory testing standards protocols for determination of the presence of various CFCs and HCFCs in polyols and rigid polyurethane foams using portable headspace gas chromatography and mass spectrometry. Finally, they reported holding trainings and workshops on using portable detectors for officers from local Ecological and Environmental Bureaus (EEBs) and establishing a whistleblower hotline and reward fund, with posted notices for employees at production enterprises.

### **Monitoring of CFC Feedstock Production in Chloromethane Facilities**

MEE has required enterprises generating CTC by-product to install verifiable and quantitative CTC online production monitoring systems.<sup>20</sup> As of September 2019, 7 enterprises had completed the installation and the rest were expected to finish installation by the end of 2019. Mandatory online monitoring of CTC by-product in all chloromethane enterprises were anticipated to be in place from 2020 onward.

### **Atmospheric Monitoring Network**

China reported forming an expert team to establish and improve monitoring technology and quality control with a plan to construct additional atmospheric monitoring stations in 2021 for monitoring to commence in 2022.<sup>21</sup> Details regarding the number of additional stations, locations, and availability and transparency of data sharing have not been reported.

## **AREAS FOR FURTHER DISCUSSION AND INFORMATION GATHERING**

The 43rd OEWG online forum on CFC-11 and virtual discussions offer the opportunity to continue discussions on key information needed to gain further clarity and certainty. Discussions should encourage gathering additional data, research, and analysis to further inform needed actions to address ongoing unreported production and use of CFC-11 and the impacts (e.g. on the size of CFC banks) of the illegal production and use of CFC-11 since 2007. Additional information sharing by China and other Parties, as well as additional expert analysis by TEAP and SAP could include:

- Deriving lessons learnt from facilities producing CFC-11 that have already been identified in China, especially regarding facilities' production methodology, raw materials and their

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<sup>19</sup> Supra, note 20.

<sup>20</sup> Ibid.

<sup>21</sup> Ibid.



routes, production capacity, location and sales markets. Further information on whether any of the illegal CFC-11 production facilities were previously producing HCFC-22 should be prioritized.

- Deriving lessons from seizure and testing of products in foam enterprises found using CFC-11 in China, including concentration of CFC-11 used and potential emissions that may be derived from widespread use in these facilities could help further confirm the size and distribution of the CFC-11 bank, and confirm TEAP's initial conclusion regarding the timing that the illegal use of CFC-11 began among other unknown factors about its use. EIA continues to urge China to undertake large-scale sampling and testing of existing PU foams in the construction and refrigeration industry.
- Reporting on domestic efforts to monitor and verify CTC production and sales. Given ongoing uncertainties in emissions originating from outside China due to lack of regional atmospheric monitoring and strong likelihood of linkages to availability of CTC feedstock, EIA recommends all Parties with CTC production for feedstock require verifiable live monitoring systems for CTC production.
- Augmenting the understanding of the supply chain of pre-blended polyols as well as the PU sector and polyol trade.
- Estimating the size, nature and emissions rates of banks of controlled gases to ensure robust enforcement with a view to building an international action plan to prevent billions of CO<sub>2e</sub> tonnes of avoidable emissions, as new scientific papers continue to underline the importance of calculating this.
- Clarifying the scientific consensus on CFC lifetimes, which has implications on CFC emissions and the size of the remaining bank.

## CONCLUSION

There remain a number of critical gaps in data and understanding of the unexpected emissions and illegal production and use of CFC-11. The CFC-11 experience has been informative, but still requires significant additional efforts to ensure the causes and impacts of this issue are fully understood and addressed and to ensure sustained implementation of the Montreal Protocol. The experience has also triggered discussion of the Montreal Protocol's institutions and controls, highlighting a broad set of shortcomings that must be addressed as well as foreshadowing several new issues that will arise in the HCFC and HFC regimes. The insights generated thus far provide a solid foundation to build upon, but a broader examination of the institutions and processes of the Montreal Protocol as a whole is necessary, in order to ensure it is prepared to take on the growing challenges of the ongoing HCFC phase-out and the new controls under the Kigali Amendment.

The failure to detect ongoing production and use of CFC-11 prior to its scientific discovery necessitates a very serious look at the current monitoring, reporting, verification (MRV) requirements and procedures of the Montreal Protocol. Parties should use the upcoming OEWG to complete the task set out in the CFC-11 contact group at OEWG 2019, and prepare to initiate a comprehensive fitness check at the next Meeting of the Parties, with clear timetables for consideration and adoption of needed improvements, whether via decisions, adjustments or future amendments.

*EIA US, PO Box 53343 Washington DC 20009 USA  
T: +1 202 483 6621  
E: [info@eia-global.org](mailto:info@eia-global.org)  
[eia-global.org](http://eia-global.org)*

*EIA UK, 62-63 Upper Street, London N1 0NY UK  
T: +44 (0) 20 7354 7960  
E: [ukinfo@eia-international.org](mailto:ukinfo@eia-international.org)  
[eia-international.org](http://eia-international.org)*





## ANNEX 1: LIST OF KEY MONTREAL PROTOCOL DOCUMENTS RELEVANT TO CFC-11 DISCUSSION

### 30th MOP (Ecuador, 2018)

- Issues from Secretariat for attention of parties:  
<https://ozone.unep.org/system/files/documents/OEWG-40-INF-2-Add-1.pdf>
- Scientific Assessment of Ozone Depletion 2018  
[SAP-2018-Assessment-report.pdf](https://ozone.unep.org/system/files/documents/SAP-2018-Assessment-report.pdf)
- Scientific Assessment Panel - Preliminary discussion of the new report on increased emissions of CFC-11  
<https://ozone.unep.org/meetings/thirtieth-meeting-parties/pre-session-documents>
- TEAP - Background Information - Overview - CFC-11 emissions  
<https://ozone.unep.org/meetings/thirtieth-meeting-parties/pre-session-documents>

### 41st OEWG (Thailand, 2019)

- Unexpected emissions of CFC-11: overview outlining the procedures under the Montreal Protocol and Multilateral Fund in response to decision XXX/3 paragraph 6  
<https://ozone.unep.org/system/files/documents/OEWG-41-3E.pdf>
- Monitoring and management system for ozone-depleting substances in China  
<https://ozone.unep.org/system/files/documents/OEWG-41-INF-7.pdf>
- Report on the International Symposium on the Unexpected Increase in Emissions of Ozone-Depleting CFC-11 - DRAFT Copy [https://ozone.unep.org/system/files/documents/CFC-11\\_Symposium\\_SPARC\\_2019-06-23.pdf](https://ozone.unep.org/system/files/documents/CFC-11_Symposium_SPARC_2019-06-23.pdf)
- TEAP May 2019: Decision XXX/3 TEAP Task Force Report on unexpected emissions of Trichlorofluoromethane (CFC-11) (Volume 3)  
[https://ozone.unep.org/sites/default/files/2020-07/TEAP\\_Task\\_Force\\_Dec\\_XXX-3\\_on\\_Unexpected\\_CFC-11\\_Emissions\\_May\\_2019.pdf](https://ozone.unep.org/sites/default/files/2020-07/TEAP_Task_Force_Dec_XXX-3_on_Unexpected_CFC-11_Emissions_May_2019.pdf)

### 63rd ImpCom (Rome, 2019)

- Report: Annex II on possible ways of dealing with illegal production and trade  
<https://ozone.unep.org/system/files/documents/IMPCOM-63-6E.pdf>

### 31st MOP (Rome, 2019)

- Unexpected emissions of CFC-11: update to the overview provided at the forty-first meeting of the Open-ended Working Group <https://ozone.unep.org/system/files/documents/MOP-31-6E.pdf>
- Report of China on progress made in the monitoring and management system of ozone-depleting substances <https://ozone.unep.org/system/files/documents/MOP-31-INF-9E.pdf>
- Unexpected emissions of CFC-11: overview outlining the procedures under the Montreal Protocol and Multilateral Fund in response to decision XXX/3 paragraph 6  
<https://ozone.unep.org/system/files/documents/OEWG-41-3E.pdf>

- Unexpected emissions of CFC-11: overview outlining the procedures under the Montreal Protocol and Multilateral Fund in response to decision XXX/3 paragraph 6 – Addendum  
<https://ozone.unep.org/system/files/documents>
- TEAP September 2019: Decision XXX/3 TEAP Task Force Report on unexpected emissions of Trichlorofluoromethane (CFC-11) - Final Report (Volume 1)  
[https://ozone.unep.org/system/files/documents/TEAP-TF-DecXXX-3-unexpected\\_CFC11\\_emissions-september2019.pdf](https://ozone.unep.org/system/files/documents/TEAP-TF-DecXXX-3-unexpected_CFC11_emissions-september2019.pdf)

#### **43rd OEWG (Online, 2021)**

- TEAP 2021: Decision XXXI/3 TEAP Task Force Report on Unexpected Emissions of Trichlorofluoromethane (CFC-11) (Volume 3)  
[https://ozone.unep.org/system/files/documents/Final\\_TEAP-DecisionXXXI-3-TF-Unexpected-Emissions-of-CFC-11-may2021.pdf](https://ozone.unep.org/system/files/documents/Final_TEAP-DecisionXXXI-3-TF-Unexpected-Emissions-of-CFC-11-may2021.pdf)
- Scientific Assessment Panel: Report on Unexpected Emissions of CFC-11 (Advance Copy)  
<SAP-April-2021-report-on-the-unexpected-emissions-of-CFC-11.pdf>

## ANNEX 2: DECISIONS TAKEN ON UNEXPECTED CFC-11 EMISSIONS

### **Decision XXX/3: Unexpected emissions of trichlorofluoromethane (CFC-11)**

*Noting* the recent scientific findings showing that there has been an unexpected increase in global emissions of trichlorofluoromethane (CFC-11) since 2012, after the consumption and production phase-out date established under the Montreal Protocol,

*Appreciating* the efforts of the scientific community in providing that information,

*Expressing serious concern* about the substantial volume of unexpected emissions of CFC-11 in recent years,

1. To request the Scientific Assessment Panel to provide to the parties a summary report on the unexpected increase of CFC-11 emissions, which would supplement the information in the quadrennial assessment, including additional information regarding atmospheric monitoring and modelling, including underlying assumptions, with respect to such emissions; a preliminary summary report should be provided to the Open-ended Working Group at its forty-first meeting, a further update to the Thirty-First Meeting of the Parties and a final report to the Thirty-Second Meeting of the Parties;
2. To request the Technology and Economic Assessment Panel to provide the parties with information on potential sources of emissions of CFC-11 and related controlled substances from potential production and uses, as well as from banks, that may have resulted in emissions of CFC-11 in unexpected quantities in the relevant regions; a preliminary report should be provided to the Open-ended Working Group at its forty-first meeting and a final report to the Thirty-First Meeting of the Parties;
3. To request parties with any relevant scientific and technical information that may help inform the Scientific Assessment Panel and Technology and Economic Assessment Panel reports described in paragraphs 1 and 2 above to provide that information to the Secretariat by 1 March 2019;
4. To encourage parties, as appropriate and as feasible, to support scientific efforts, including for atmospheric measurements, to further study the unexpected emissions of CFC-11 in recent years;
5. To encourage relevant scientific and atmospheric organizations and institutions to further study and elaborate the current findings related to CFC-11 emissions as relevant and appropriate to their mandate, with a view to contributing to the assessment described in paragraph 1 above;
6. To request the Secretariat, in consultation with the secretariat of the Multilateral Fund for the Implementation of the Montreal Protocol, to provide the parties with an overview outlining the procedures under the Protocol and the Fund with reference to controlled substances by which the parties review and ensure continuing compliance with Protocol obligations and with the terms of agreements under the Fund, including with regard to monitoring, reporting, and verification, and to provide a report to the Open-ended Working Group at its forty-first meeting and a final report to the Thirty-First Meeting of the Parties;
7. To request all parties:
  - a. To take appropriate measures to ensure that the phase-out of CFC-11 is effectively sustained and enforced in accordance with obligations under the Protocol;
  - b. To inform the Secretariat about any potential deviations from compliance that could contribute to the unexpected increase in CFC-11 emissions;

### **Decision XXXI/3: Unexpected emissions of CFC-11 and institutional processes to be enhanced to strengthen the effective implementation and enforcement of the Montreal Protocol**

RECALLING decision XXX/3 on unexpected emissions of trichlorofluoromethane (CFC-11), in particular the mandate therein to the Scientific Assessment Panel to provide additional information in that regard to the parties in 2020,

RECALLING ALSO decision XIV/7 on monitoring of trade in ozone-depleting substances and preventing illegal trade in ozone-depleting substances, in paragraph 7 of which parties were requested to report information on illegal trade to the Ozone Secretariat,

TAKING INTO ACCOUNT information provided by the Technology and Economic Assessment Panel and the Scientific Assessment Panel on the emissions of CFC-11 and their likely sources, and that parties remain concerned about the implications of those emissions for the ozone layer,

TAKING NOTE of the report on the International Symposium on the Unexpected Increase in Emissions of Ozone-depleting CFC-11, held in March 2019,

TAKING NOTE ALSO of document UNEP/OzL.Pro/ExCom/83/38 on current monitoring, reporting, verification and enforceable licensing and quota systems, referred by the Executive Committee of the Multilateral Fund to the parties for their consideration,

EXPRESSING APPRECIATION for the information that parties have provided to the Technology and Economic Assessment panel, to the Open-Ended Working Group at its forty-first meeting, and to the Thirty-First Meeting of the Parties to assist with further analysis of the unexpected emissions of CFC-11, in particular the information contained in document UNEP/OzL.Pro.31/INF/9,

TAKING NOTE of the document on possible ways of dealing with illegal production of and illegal trade in controlled substances under the Montreal Protocol, as set out in annex II to the report of the Implementation Committee under the Non-Compliance Procedure for the Montreal Protocol at its sixty-third meeting,

1. To request any party that becomes aware of information on CFC-11 emissions that indicates that the party has exceeded its maximum-allowed level of production or consumption of CFC-11 to submit to the Secretariat without undue delay a description of the specific circumstances that it considers to be the cause of the unexpected CFC-11 emissions;
2. To remind parties to update their Article 7 reports if they become aware of new data;
3. To remind parties, consistent with paragraph 1 of decision XXII/20, to report all production of controlled substances, whether intended or not intended, to enable the calculation of production and consumption in accordance with Article 3 of the Protocol;
4. To encourage parties to take steps to ensure that controlled substances produced for feedstock are not directed towards non-feedstock purposes or for the illegal production of CFC-11;
5. To encourage all parties to take action to discover and prevent the illegal production, import, export and consumption of controlled substances by:
  1. Implementing the Montreal Protocol obligations in a manner that is effective in discovering and preventing illegal production of controlled substances;
  2. Considering national prohibitions, as appropriate, on the use of controlled substances either prior to or after their phase-out;

3. Reporting fully proved cases of illegal trade in controlled substances to the Ozone Secretariat in order to facilitate an exchange of information;
4. Reporting to the Ozone Secretariat on how significant cases of illegal production, import, export or consumption have been addressed and to their best knowledge what were the causes, in order to facilitate an exchange of information;
6. To remind parties to ensure that any imports and exports of controlled substances for feedstock and exempted uses are included in licensing systems;
7. To request the Technology and Economic Assessment Panel to provide the parties with an update to the information provided pursuant to paragraph 2 of decision XXX/3, and to provide a report thereon to the Thirty-Second Meeting of the Parties, including any new compelling information that becomes available, as well as providing information on the following:
  1. An analysis of CFC-11 banks by geographic location and by market sector;
    2. Linkages between the level of production of anhydrous hydrogen fluoride and carbon tetrachloride and unexpected emissions of CFC-11;
    3. The types of CFC-11 products, the disposition of any such products, and opportunities and methods to detect such products and potentially recover the associated CFC-11;
    4. Identification of possible drivers of illegal production of and trade in CFC-11, such as the availability of technically and economically feasible alternatives to CFC-11 and HCFC-141b and their sustained effectiveness;
8. To request the Scientific Assessment Panel to work with the Ozone Research Managers at their meeting in 2020 to identify gaps in the global coverage of atmospheric monitoring of controlled substances and to provide options on ways to enhance such monitoring, as well as exploring options for informing the parties of preliminary information indicating unexpected emissions of controlled substances, for the consideration of the Thirty-Second Meeting of the Parties to the Montreal Protocol and the Conference of Parties to the Vienna Convention at its twelfth meeting, in 2020;
9. To invite parties to provide to the Ozone Secretariat, as soon as possible, any available CFC-11 atmospheric monitoring data that are relevant to the unexpected CFC-11 emissions, and to request the Secretariat to make that data available to the parties.