

Semiconductor Industry Concerns with Inclusion of Abatement Requirement in Product Environmental Standards

The semiconductor industry has several technical and other concerns with the inclusion of an abatement requirement in a standard for servers or other technology products. As a preliminary matter, it is important to emphasize three points of context:

1. Commitment of the Semiconductor Industry to Reducing Greenhouse Gas (GHG) Emissions – The semiconductor industry has a longstanding and successful record of reducing emissions of perfluorinated compounds (PFCs) into the atmosphere. Under the auspices of the World Semiconductor Council (WSC), comprised of the major semiconductor-producing countries and regions (China, Chinese Taipei, Europe, Japan, Korea, and the United States), the global industry has an ongoing voluntary program to reduce its emissions of PFCs. In the late 1990s, the WSC announced an ambitious goal to reduce absolute PFC emissions by 10 percent by 2010. (In recognition of this effort, the U.S. EPA awarded one of its first Climate Protection Awards to the WSC.) In 2011, the WSC announced that it far surpassed this reduction goal and achieved a 32 percent reduction. See http://www.semiconductorcouncil.org/wsc/uploads/WSC_2011_Joint_Statement.pdf (page 6). These results were achieved through a variety of measures, including process optimization, material substitution and abatement. Building on this success, the WSC announced a new PFC 2020 goal based on the implementation of best practices at new fabs. We anticipate that the implementation of these best practices will result in a Normalized Emission Rate (NER) based on PFC emissions per square centimeter of silicon wafers produced of 0.22 kilograms of carbon dioxide equivalent by square centimeter ($\text{kgCO}_2\text{e/cm}^2$), which is equivalent to a 30 percent NER reduction from the 2010 aggregated baseline. As of 2014, the WSC is making solid progress toward achieving this new goal.
2. The Semiconductor Industry Contributes a Tiny Amount of GHG Emissions – Partly as a result of these ongoing efforts to reduce emissions, the semiconductor industry constitutes a very small fraction of overall GHG emissions. In the U.S., for example, EPA's most recent reporting data shows that emissions from industrial sources covered under 40 CFR 98 Subpart I (which includes all electronics manufacturing, including non-semiconductor sources) was 5.7 million metric tons of carbon dioxide equivalents (MMmt CO_2e), and total emissions from all industrial sources was 3,204 MMmt CO_2e . Accordingly, emissions from all electronics manufacturing, including semiconductors, amounted to only 0.18 percent of total emissions from industrial sources. In 2013, total U.S. GHG emissions from all sources (not just industrial sources) were 6,673 MMmT CO_2e . Total emissions from semiconductor manufacturing was 4.2 MMmT CO_2e (using a different reporting methodology than in 2014), or 0.063 percent of the total.
3. F-GHGs are critical to the production of semiconductors – Fluorinated greenhouse gases (F-GHGs) are critical to semiconductor manufacturing because they provide uniquely effective process performance when etching high aspect ratio features, and are a safer, reliable source of the fluorine needed to clean certain deposition process chambers. These gases are used in small quantities and are subject to extensive controls, and cannot always be abated.

We have been informed that the draft NSF standard for servers requires the use of abatement for all equipment that use F-GHG and nitrous oxide (N_2O). Given the points referenced above, we question the value of imposing this requirement. In addition, this proposed requirement was

adopted without the input of semiconductor manufacturers. As a result, there are numerous problems with such a requirement.

Technical Issues

- A rigid requirement of using abatement ignores the pollution prevention hierarchy to reduce emissions. The industry's success in emissions reduction has often been the result of the use of alternative chemistries and process optimization, followed by abatement as the last choice. It is inappropriate to impose a requirement to use "end-of-pipe" abatement without giving credit for other preferred means of reducing emissions.
- Different tools and processes do not use process GHGs at the same rate and do not have equivalent utilization efficiencies. Under these circumstances it makes little sense to require abatement on all tools. For example, as documented in data provided to EPA in developing the GHG reporting rule with regard to remote nitrogen trifluoride (NF₃) chamber cleans, some processes make extremely efficient use of NF₃ (i.e., processes that consume 98 percent of the gas). For these processes, abatement provides very little additional value.
- Requiring abatement for N₂O processes makes little sense when the industry has not demonstrated an abatement technology that works for this gas. Abatement of N₂O often generates nitrogen oxides (NO_x) which are regulated air pollutants.
- The draft server standard requires that the semiconductor manufacturer work with the abatement system supplier to develop and adhere to company-specific operation and maintenance procedures and schedules. The display standard requires that control technologies are designed installed, operated and maintained in accordance with the control technology supplier's specifications and that the supplier create a maintenance plan. These requirements can be inconsistent with the established commercial relationships developed between the semiconductor manufacturer and their abatement suppliers. While some manufacturers have established maintenance plans with their suppliers, some do not and the suppliers seek to charge extra fees for this service.

Harmonization Concerns

The requirements would not be easily adopted in regions outside the U.S.

- The draft server standard expands the basket of covered gases to include N₂O and fluorinated heat transfer fluids (F-HTFs). The reporting methodology in the U.S. includes these additional gases, but other regions do not report on emissions of these gases.
- The draft standard requires that emissions be expressed in tons of CO₂e. However, not all countries/regions use the same values to calculate the global warming potential (GWPs) for all gases. For example, US EPA has adopted GWPs that are different than the IPCC.
- The draft standard requires that the supplier publicly report its emissions of N₂O and F-GHGs. This is an established practice in the U.S., but this requirement is not accepted by other regions.
- The requirement for maintenance plans is inconsistent with the practice of other regions.
 - Facilities reporting under the U.S. reporting protocol are required to develop a site-specific maintenance plan, but based on our collaboration with other regions as part of the WSC, this is not a requirement outside the U.S.
- While EPA has established default destruction/removal efficiency (DRE) that can be used for reporting based on extensive data provided by the semiconductor industry and

suppliers, the standard requires the semiconductor manufacturer test abatement systems in accordance with EPA's DRE Protocol or procedures outlined in subpart I.

- The standard requires that the semiconductor manufacturer has tested the abatement systems in accordance with U.S. test methods. This U.S.-centric requirement goes beyond the practices of other regions.

Conclusion

A product standard is not the appropriate place to impose requirements governing abatement in semiconductor manufacturing. We recommend that the final standard omit this criterion. Any future consideration pertaining to semiconductor manufacturing should be addressed in consultation with the semiconductor industry.