Subject: Carbon Footprinting of Electronics
From: Olivetti Group - Massachusetts Institute of Technology (MIT)

Main Point

To reduce greenhouse gas (GHG) emissions, several national and international governmental organizations (including the U.S. Environmental Protection Agency) have developed GHG reporting guidelines for electronics manufacturing and use. However, current methods of calculating and reporting GHG emissions do not properly account for uncertainties, making it impossible to accurately compare the carbon impact of different products. The Olivetti Group at MIT has furthered methods for efficiently incorporating uncertainties in the carbon footprinting of electronics. This methodology identifies where the industry can best spend limited resources to reduce uncertainty and ultimately reduce GHG emissions.

Background

Background: Carbon footprinting allows a company or an industry to pinpoint the most carbon intensive process in their supply chain. There are many sources of uncertainty inherent to these calculations, including the use of inaccurate or incomplete data and the inherent variability in the system. Despite the presence of uncertainty in carbon footprints, practitioners often present results as single deterministic values. This may give the impression that one product has a smaller carbon footprint than another when in reality the differences are not statistically significant. In addition, traditional methods of calculating these footprints require detailed information about emissions from every step in the manufacturing process. Compiling this information can be challenging and require significant resources, especially for technologies such as semiconductors where the product profile, supply chain, and technology are rapidly evolving. **Therefore, methods are needed to quantify the uncertainty in carbon footprints in an effective and efficient manner.**

Evidence

Footprinting Methodology: In collaboration with several electronics firms, the Olivetti Group at MIT has incorporated uncertainty into a high-level carbon footprint of electronics to determine the major contributors to both the overall footprint as well as the uncertainty. The following figure shows the global warming potential for the production of an industry-average microprocessor made in 2013 with emissions broken down by scope of production. The major contributors to the total emissions are scope 2 emissions, followed by scope 1 emissions. The total carbon footprint has a 100% uncertainty; however, analysis shows that this can be reduced to 10% uncertainty by fully specifying just 3 of the 150 production parameters.

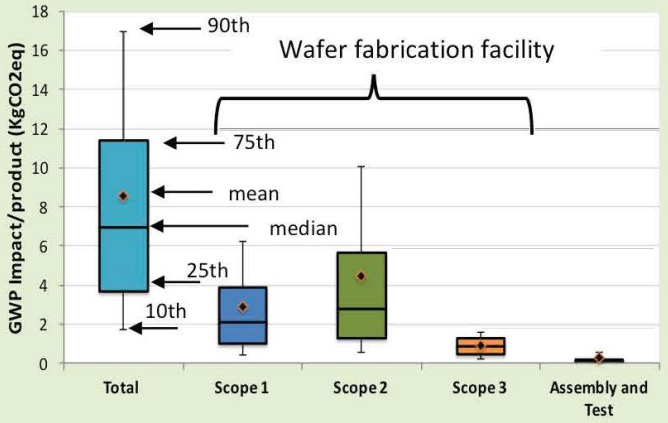

Figure 1: Emissions impact with associated uncertainty for industry-average microprocessor made in 2013. The diamond represents the mean value, the bottom and the upper whiskers are the 10th and the 90th percentile, respectively, the bottom and the top of the box are the 25th and 75th percentile and the middle line represents the median value.

Conclusions and Implementation

These results demonstrate that carbon footprints can be highly uncertain and that comparisons between products (or across mitigation strategies) might be insignificant once the error bars are included. In addition, these error bars can be greatly reduced by gathering data on just the top contributors to uncertainty. **Therefore, robust carbon footprints, which takes into account uncertainty, have the ability to better compare products and help identify where resources are best allocated to mitigate emissions.**