**Supplemental Material**

**Possible malfunction in widely used methane sampler deserves attention but poses limited implications for supply chain emission estimates**

Ramón A. Alvarez,\*,1 David R. Lyon,1 Anthony J. Marchese,2 Allen L. Robinson3 and Steven P. Hamburg1

1 Environmental Defense Fund, Austin TX 78701

2 Department of Mechanical Engineering, Colorado State University, Fort Collins, CO 80523

3 Department of Mechanical Engineering, Carnegie Mellon University, Pittsburgh, PA 15213

*The Discussion section in the main paper refers to the possibility that natural gas production rates may influence the magnitude of emissions from individual leaks. Here we present additional analysis of the Equipment Leak (EL) dataset in Allen et al (2013) that examines this possibility. Supplemental Material also includes a digital Excel file with Allen et al (2013) data, our analytical calculations, and additional figures.*

Site-level methane emissions of production sites can be influenced by site gas production rates, with low production sites having lower absolute emission rates but higher production-normalized emission rates.1,2 It is possible that individual leak rates may also be influenced by the rate of gas production. The Allen et al (2013)3 dataset indicates that sites with lower %CH4 tend to have lower gas production than sites with higher %CH4 (2.1, 6.3, and 8.0 thousand standard cubic feet per day for <91%, 91-97%, and >97% CH4 sites, respectively). Individual leaks from the EL dataset in Allen et al (2013) can be converted from absolute emission rate to proportional loss rate (percent of site-produced CH4 emitted) using the site-specific gas production and gas composition. The mean and median of the proportional loss rate of individual leaks are higher for sites with lower %CH4 (Table S1, Figures S1, S2, S3). Moreover, the distributions of proportional loss rates for the lower %CH4 sites are skewed toward higher values compared to the higher %CH4 sites. This suggests that the lower absolute emission rates at sites with lower %CH4 may be partially attributable to lower production rates, instead of BHFS sensor transition failure. As discussed in the main paper, the fact that other factors like gas production rates may contribute to the observed differences in emission rates reduces the likelihood that the potential underestimation in the UT Production Studies due to BHFS failure alone is as large as our constrained estimate.

**References**

1. Zavala-Araiza, D.; Lyon, D.; Alvarez, R. A.; Palacios, V.; Harriss R., Lan, X.; Talbot, R.; Hamburg, S. P. Toward a functional definition of methane super-emitters: Application to natural gas production sites. *Environ. Sci. Technol.* **2015**, *49*, 8167–8174.
2. Omara, M.; Sullivan, M. R.; Li, X.; Subramanian, R.; Robinson, A. L. ; Presto, A. A. Methane Emissions from Conventional and Unconventional Natural Gas Production Sites in the Marcellus Shale Basin. *Environ. Sci. Technol.* **2016**, *50*, 2099–2107*.*
3. Allen, D. T.; Torres, V. M.; Thomas, J.; Sullivan, D. W.; Harrison, M.; Hendler, A.; Herndon, S. C.; Kolb, C. E.; Fraser, M. P.; Hill, A. D.; Lamb B. K,; Miskimins, J.; Sawyer, R. F.; Seinfeld, J. H. Measurements of methane emissions at natural gas production sites in the United States. *Proc. Natl. Acad. Sci. U.S.A.* **2013**, *110,* 17768–17773.