

# Methane leaks from North American natural gas systems: 4 key findings

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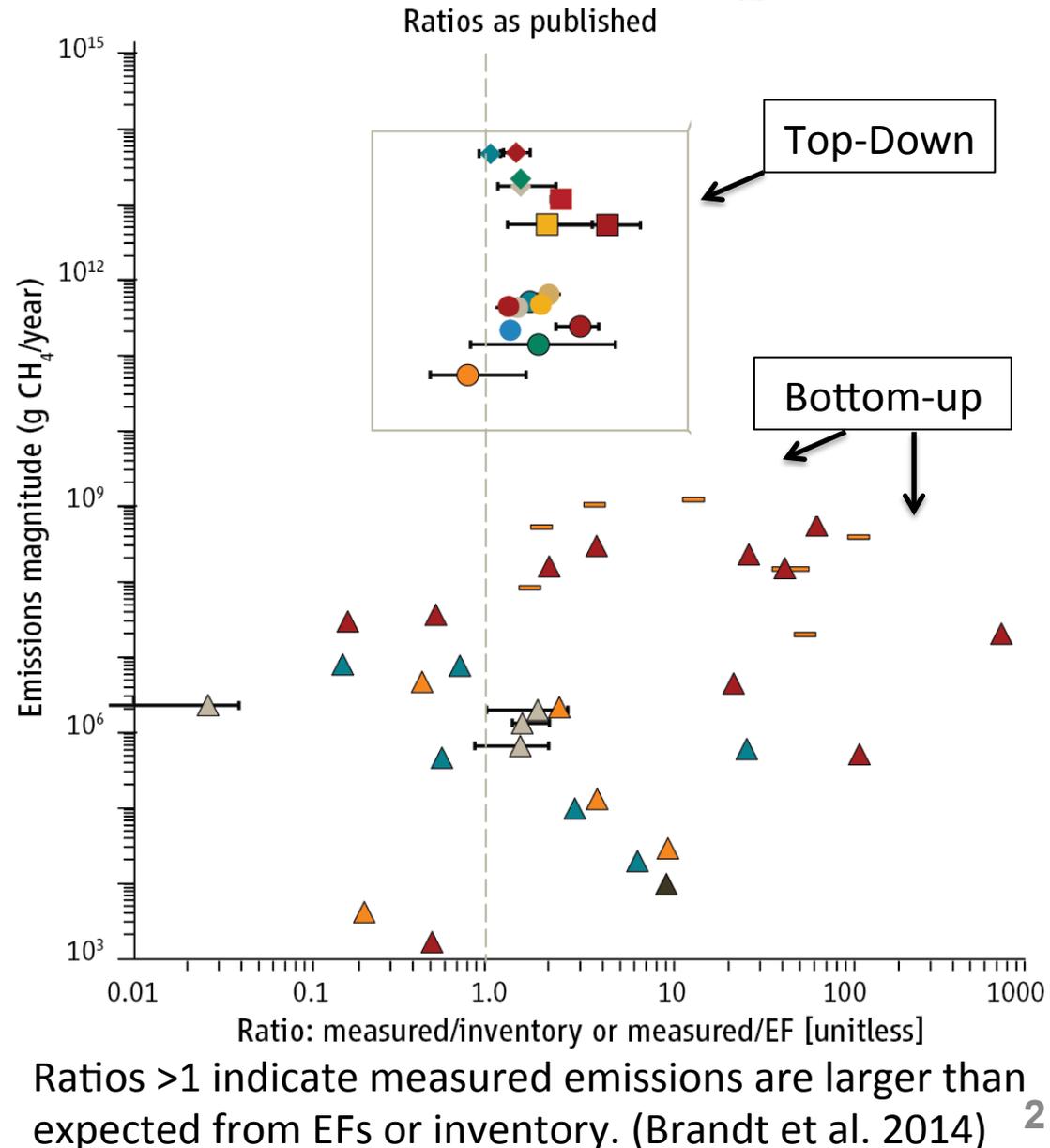
Presentation to GEIA conference, June 11, 2014

- Goal: To better understand natural gas leakage rates by critically analyzing available evidence
  - Many studies over 20+ years, but no synthesis
- Method: Assemble experts to review existing literature
  - Reviewed ~200 scientific and technical references
- Organized by Novim (UCSB, Institute for Theoretical Physics)
- Funded by: Cynthia and George Mitchell Foundation



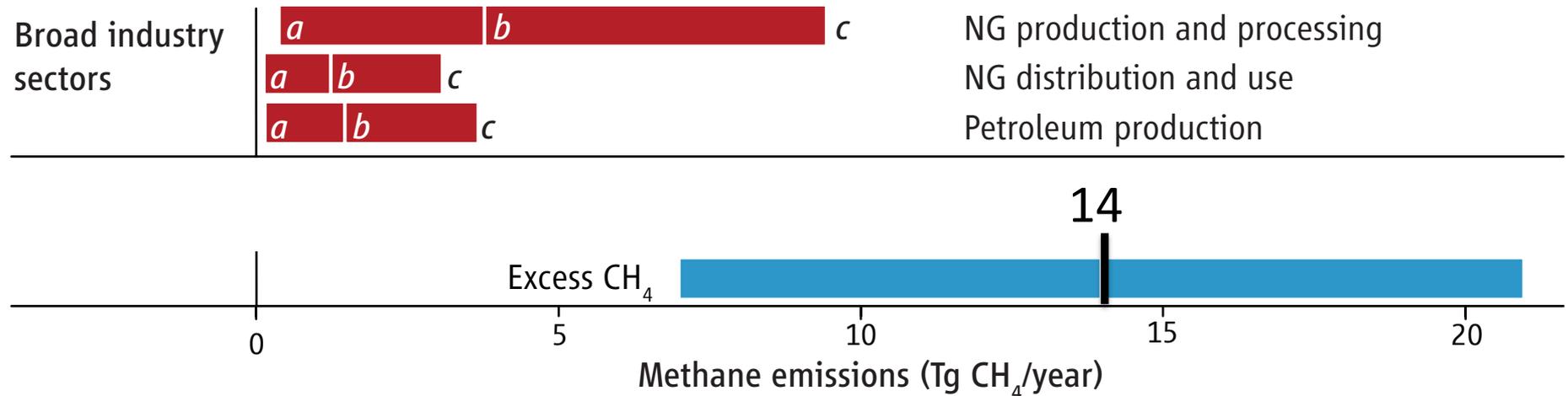
# Result #1: Inventories underestimate methane ( $\text{CH}_4$ ) emissions

- Evidence at all scales (y-axis) from numerous empirical studies consistently have found that  $\text{CH}_4$  emissions are larger than those estimated by EPA inventory
- National-scale top-down studies suggest that total U.S.  $\text{CH}_4$  emissions are 50% higher than EPA estimates (uncertainty range = 25 – 75% higher)
  - 14 million tonnes of excess  $\text{CH}_4$  per year (range 7 to 21)
- Excess  $\text{CH}_4$  emissions from the NG industry are very likely to contribute to this excess, but exact contribution is still uncertain**



# Result #2: High emissions from recent studies in certain basins unlikely representative nationally

**Thought experiment to explore what could contribute to 14 Tg excess:**



## Broad industry sectors

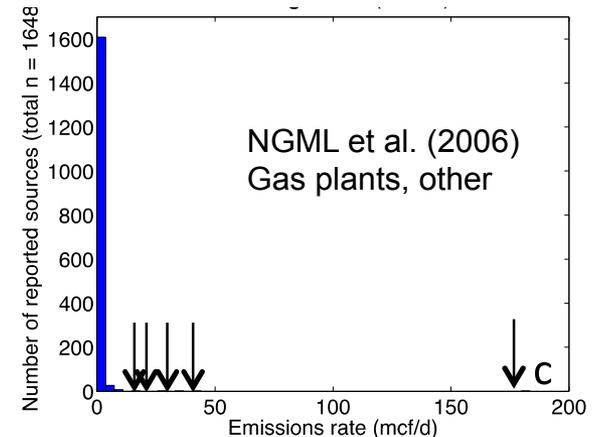
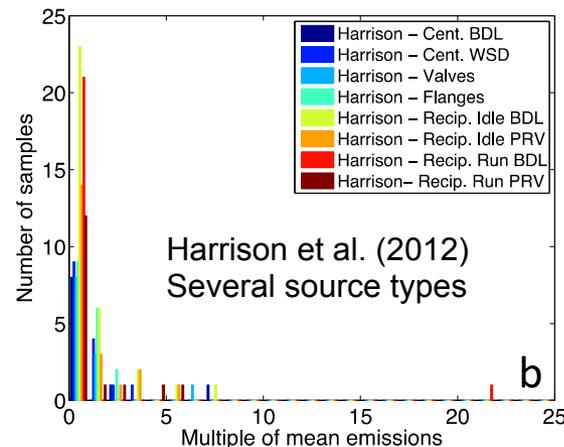
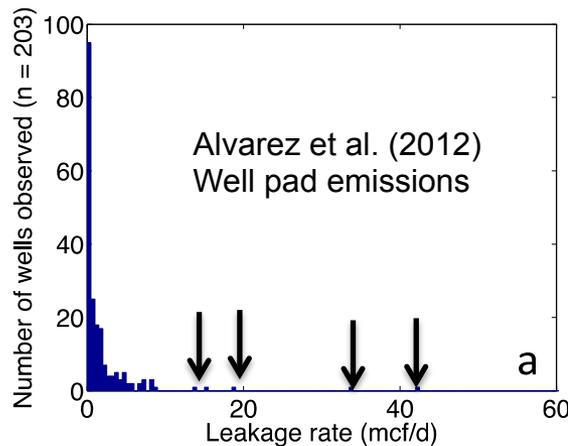
- Example: NG production and processing:
  - Leakage rate of 9% (Karion et al. (2013) data from Uintah Basin UT)
  - Apply this to 1%, 10% and 25% of US gas production, compute excess
- **Result:** High emissions rates from recent atmospheric studies (UT, LA) are not the norm. If so, we would see more methane from the continental/national atmospheric studies.

# Result #3: Small number of “super-emitters” could be responsible for large fraction of emissions

Bottom-up studies<sup>1</sup> suggest that unintentional leakage rates vary greatly between devices

- Vast majority of sources leak very little
- A **very** small fraction ( $\ll 1\%$ ) leak a large amount. These sources often contribute a large fraction of the total leakage

*An example: 50 out of 75,000 source points (0.06%) resulted in 60% of all emissions.*



<sup>1</sup>See Table S6 in paper SM for tabular evidence of “super-emitters”, and Figure S2

# Result #4: Coal to NG fuel substitution likely still climate favorable using 100 year GWP framework

- Leakage rates from the NG system are unlikely to be high enough to disfavor coal to NG substitution for electricity generation (100 year global warming potentials)
  - To favor coal: high estimate of undercounted emissions (1.75x EPA); all excess CH<sub>4</sub> from NG industry.
  - We know other sources contribute (livestock emissions)
- Climate benefits from using NG in transportation are uncertain (for gasoline cars) or unlikely (for heavy-duty diesel vehicles)

## Additional notes:

<sup>1</sup>Fuel switching benefits defined using cutoff percentages from Alvarez et al. (2012)

# Need for more science

- Atmospheric studies have uncertainty due to challenges inherent in atmospheric modeling
    - More scientific development needed to improve attribution and reduce uncertainty
  - Measurements from facilities' current operations are lacking
    - Need much more data from variety of emission sources
    - Need broader participation in studies (e.g., large and small operators) and variety of methods
  - Work is ongoing around the country in these areas (EDF effort, many national laboratories and universities)
- Closing the gap between estimates from top-down and bottom-up approaches is a key challenge that requires specific focus