

Reconciling region-, facility-, & component- level emissions data

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Daniel Zavala-Araiza

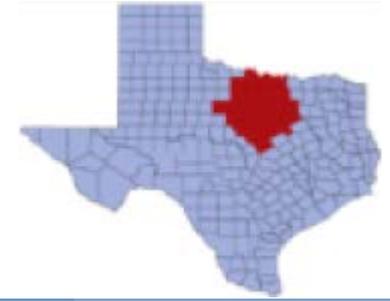
Ramon Alvarez

Steven Hamburg

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Barnett Shale

October 16 – 30, 2013



EDF COORDINATED CAMPAIGN

PRODUCTION

GATHERING/PROCESSING

TRANSMISSION/STORAGE

LOCAL DISTRIBUTION

TRUCKS AND STATIONS

NOAA/CU/Michigan
Scientific Aviation/Penn State

Purdue University

Sander Geophysics

Princeton/
University of Texas - Dallas

Picarro/
Duke University

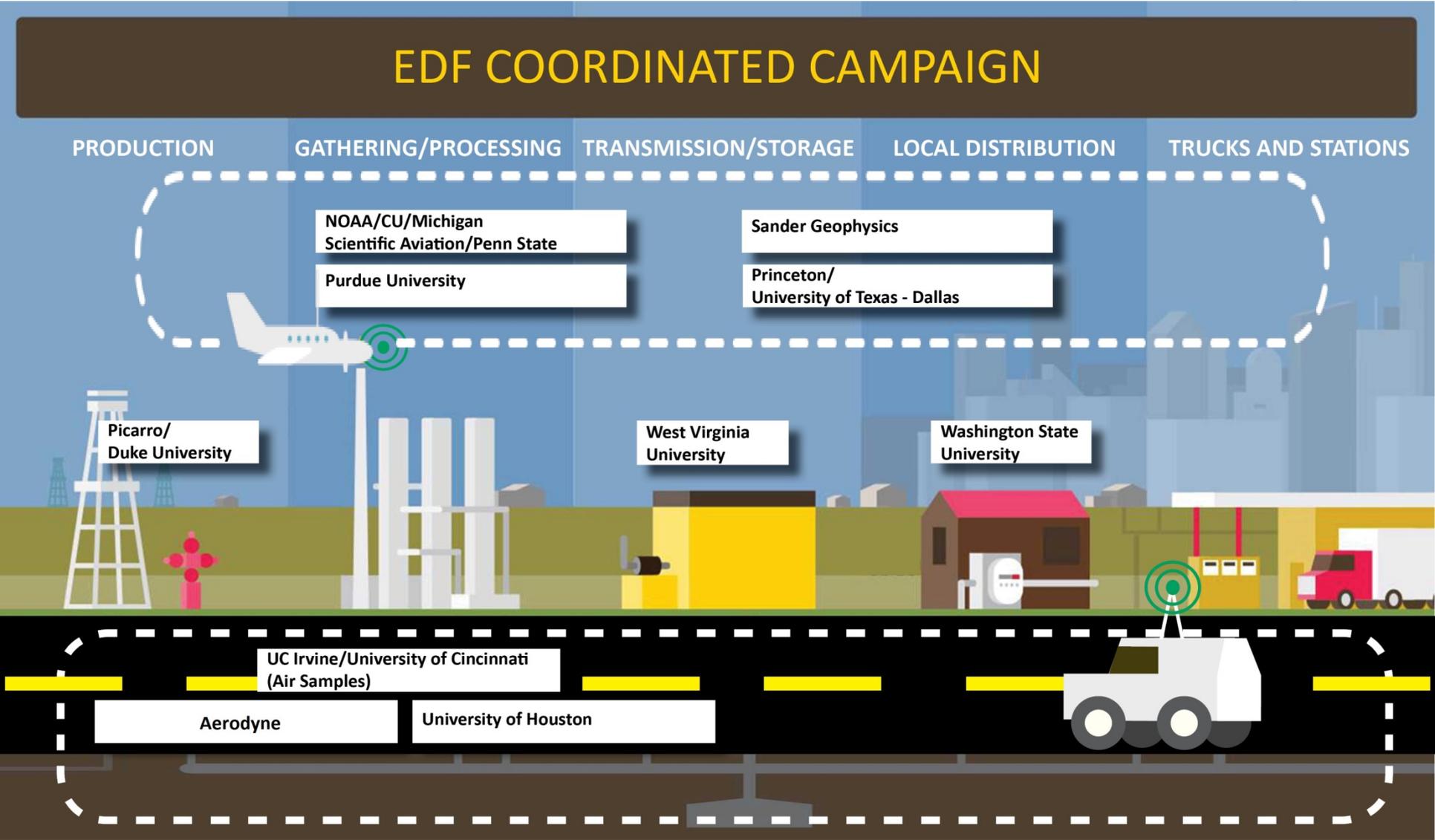
West Virginia
University

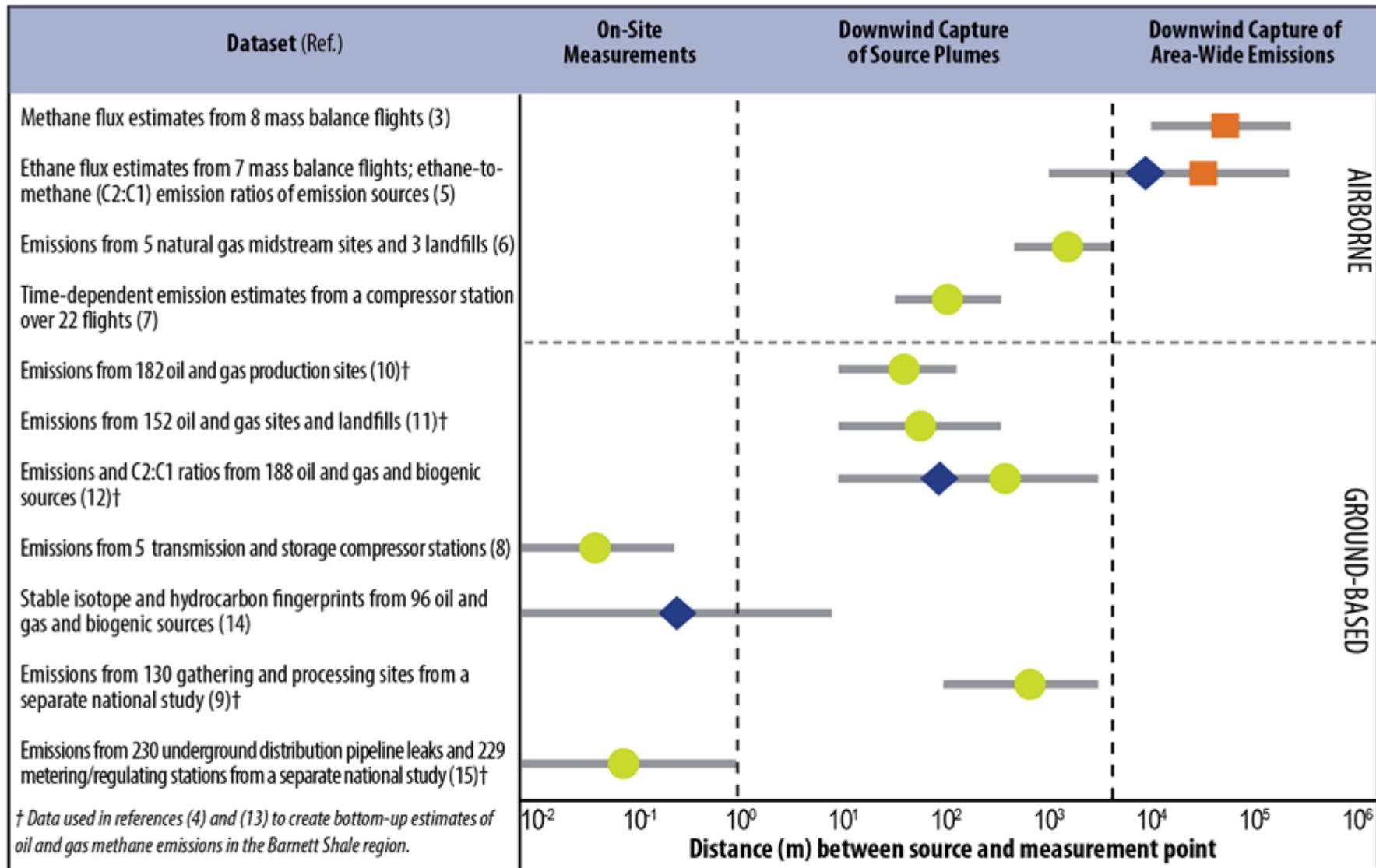
Washington State
University

UC Irvine/University of Cincinnati
(Air Samples)

Aerodyne

University of Houston





Data Types: ■ Regional Flux Estimate ◆ Source Fingerprint ● Component-or site-level emission distribution

Figure 1. Multi-scale measurements used to characterize methane emissions from oil and gas sources in the Barnett Shale.

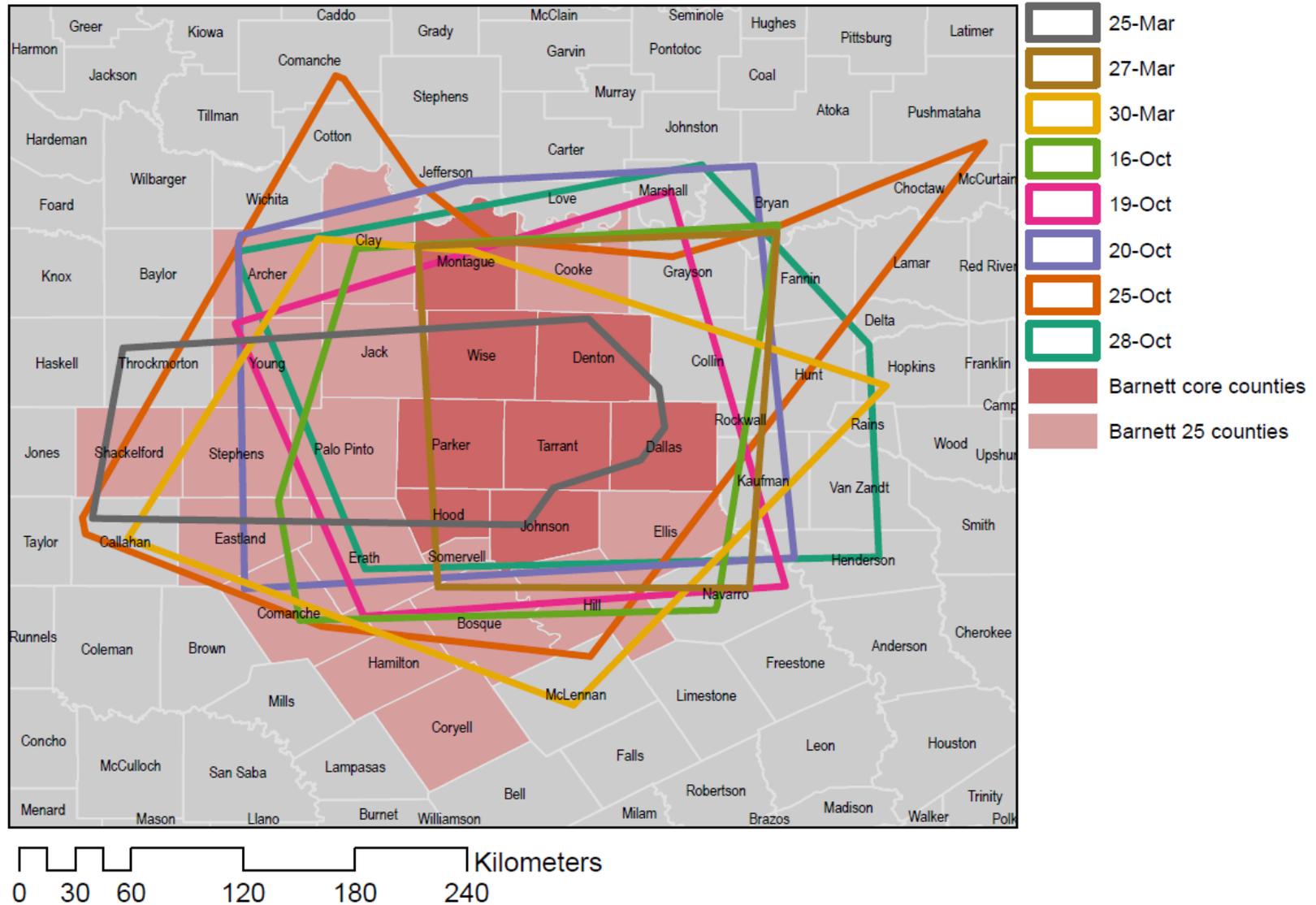
Different measurement scales

- Region-level
 - aircraft mass balance, tower & satellite inversion modeling
- Facility-level
 - tracer flux, near-field dispersion modeling & mass balance
- Component-level
 - direct flow measurements, bagging, metering



Regional mass balance

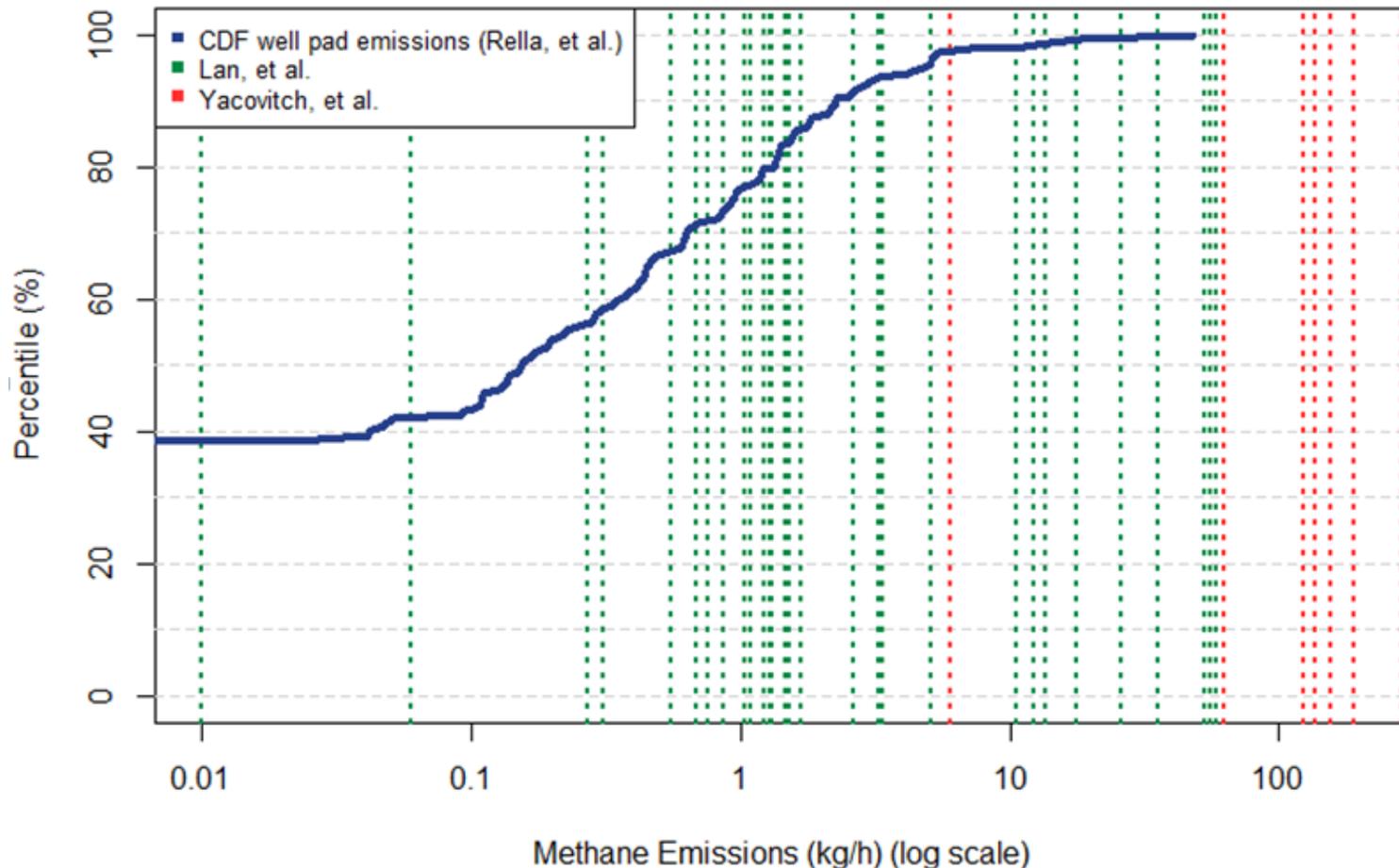
76 ± 13 total and 60 ± 11 fossil metric tons $\text{CH}_4 \text{ hr}^{-1}$
 $\approx 1.3 - 1.9\%$ loss rate (Karion et al., Smith et al.)



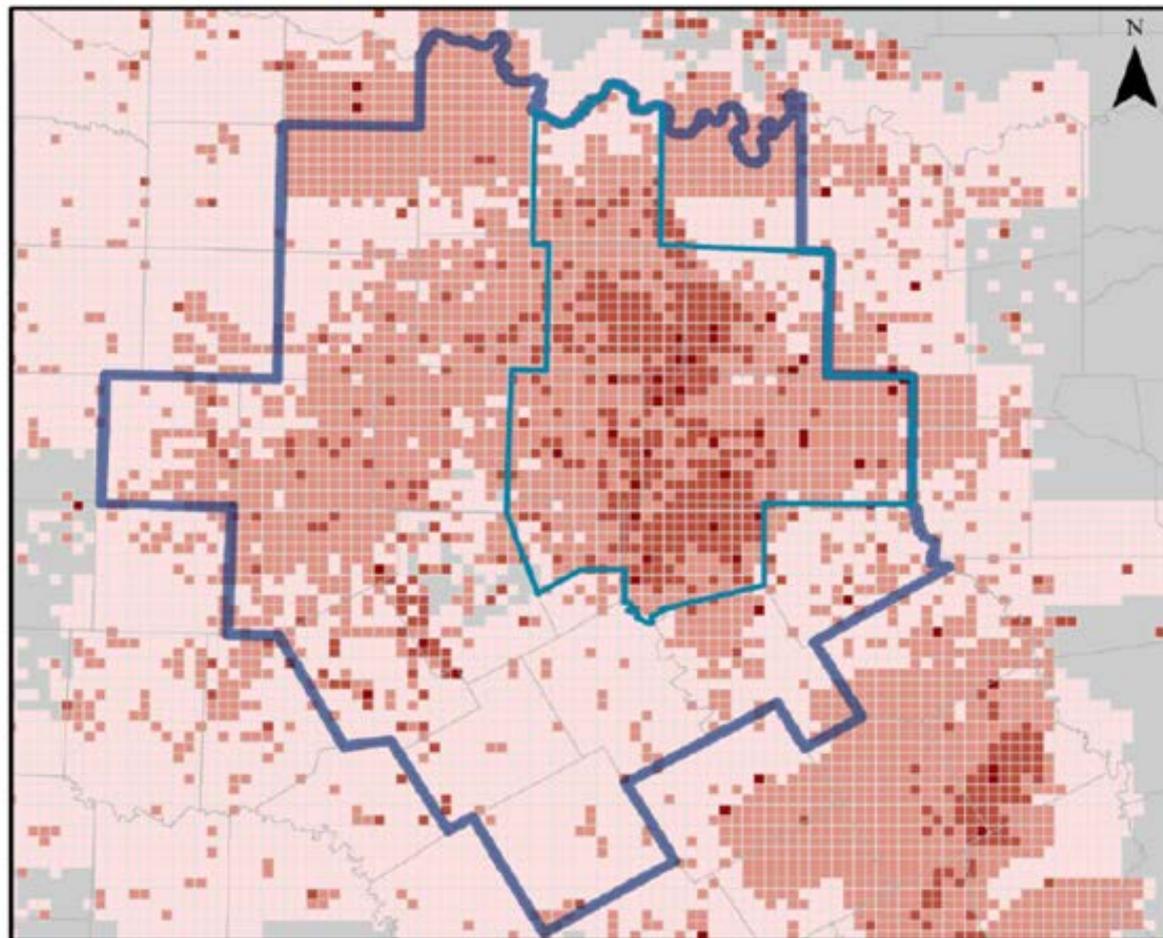
Facility-level emissions inventory

72 (+10/-9) total & 46(+8/-6) O&G metric tons CH_4 hr^{-1}
 $\approx 1.0 - 1.4\%$ loss rate (Lyon et al.)

Barnett Well Pad Emission Rate Distribution

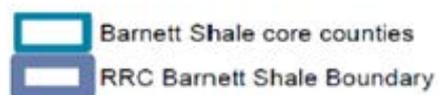
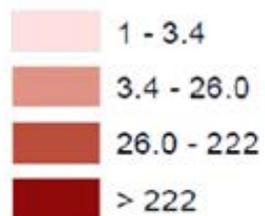


Total Methane Emissions



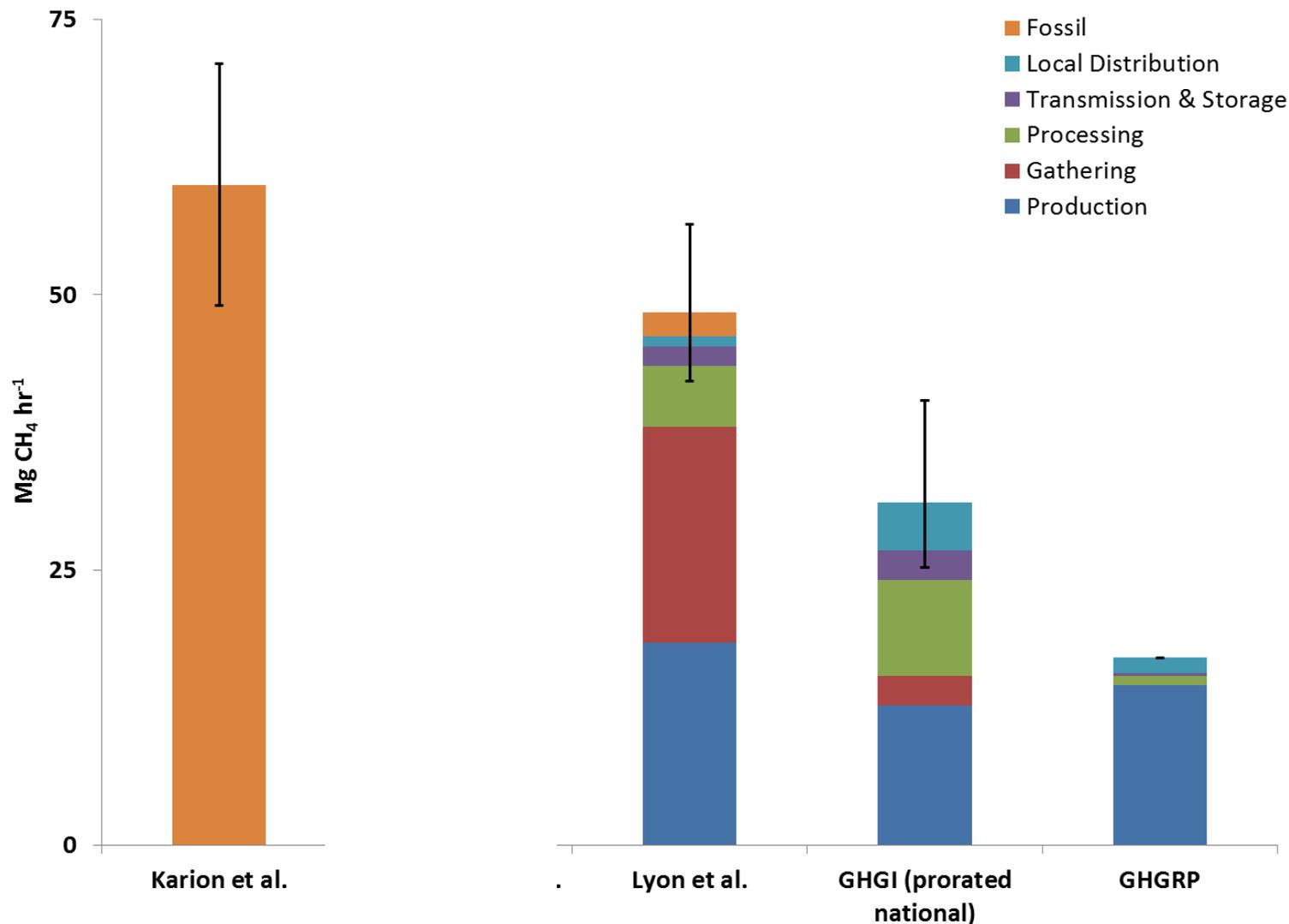
0 20 40 80 120 160
Kilometers

Methane Emissions (kg/h)



Lyon et al.

Barnett O&G CH₄ Emission Estimates



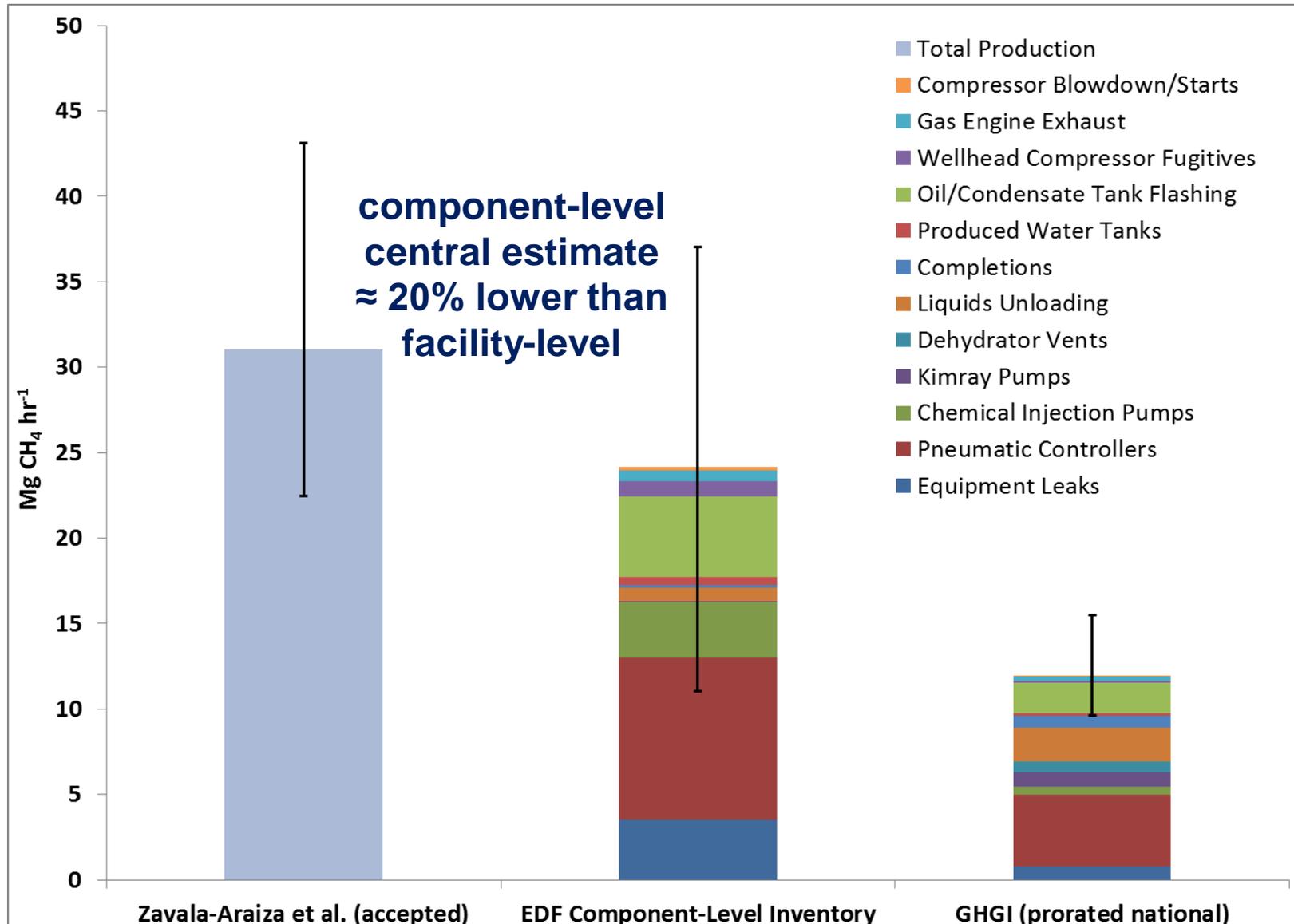
Karion et al. estimate is average of flight envelopes. Other estimates are for 25 county region.

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Barnett production segment component-level inventory

- Regional activity factors
 - Drillinginfo
 - TX Railroad Commission
 - GHGRP
- Regional & national emission factors
 - GHG Inventory
 - UT production studies
 - Environ/CenSARA O&G inventory
 - HARC/TCEQ tank reports
 - AP-42 engine exhaust

Barnett Production CH₄ Emission Estimates



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Insights from multi-scale comparison

- Region- and facility-level based estimates of Barnett O&G methane emissions are similar.
- Regional variation in activity factors result in different component-level estimates than prorated national GHGI.
- Some source estimates improved with updated EFs.
- Current best estimates component-level emissions are lower than facility-level estimate but with overlapping uncertainty.
- “Super-emitter” sources may explain the difference.
 - e.g., stuck dump valves, blowdowns, tank control malfunctions