Minimizing Environmental Impacts from Oil and Gas Operations

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EDF
ENVIRONMENTAL DEFENSE FUND®
Finding the ways that work

Widely Acknowledged The Oil and Gas Boom Has Clear Advantages…

- Economic development
- Increased energy security
- Less air pollution
- Fewer greenhouse gases (GHG) from combustion than coal.

… *IF* done the right way.

And Potential Risks…

- Ground and surface-water contamination
- Air emissions threaten public health
- Impacts from truck traffic, noise, lights, etc…
- **Increased GHG emissions**

… if *NOT* done correctly.

- Benefits cannot be realized if risks aren't significantly reduced.
- Lack of public trust due to risks is becoming one of the largest obstacles for drilling.
- **It is in everybody's interest to minimize these risks.**

Colorado is Leading the Way

- First direct regulation of oil and gas methane.
- Dramatic reductions in “fugitive” emissions including monthly inspections at the largest sources.
- Retrofit key high-emitting existing sources with low-emitting equipment.
- Statewide requirements to target reductions from under-regulated but important sources of emissions from well maintenance activities.

Climate Implications of Methane

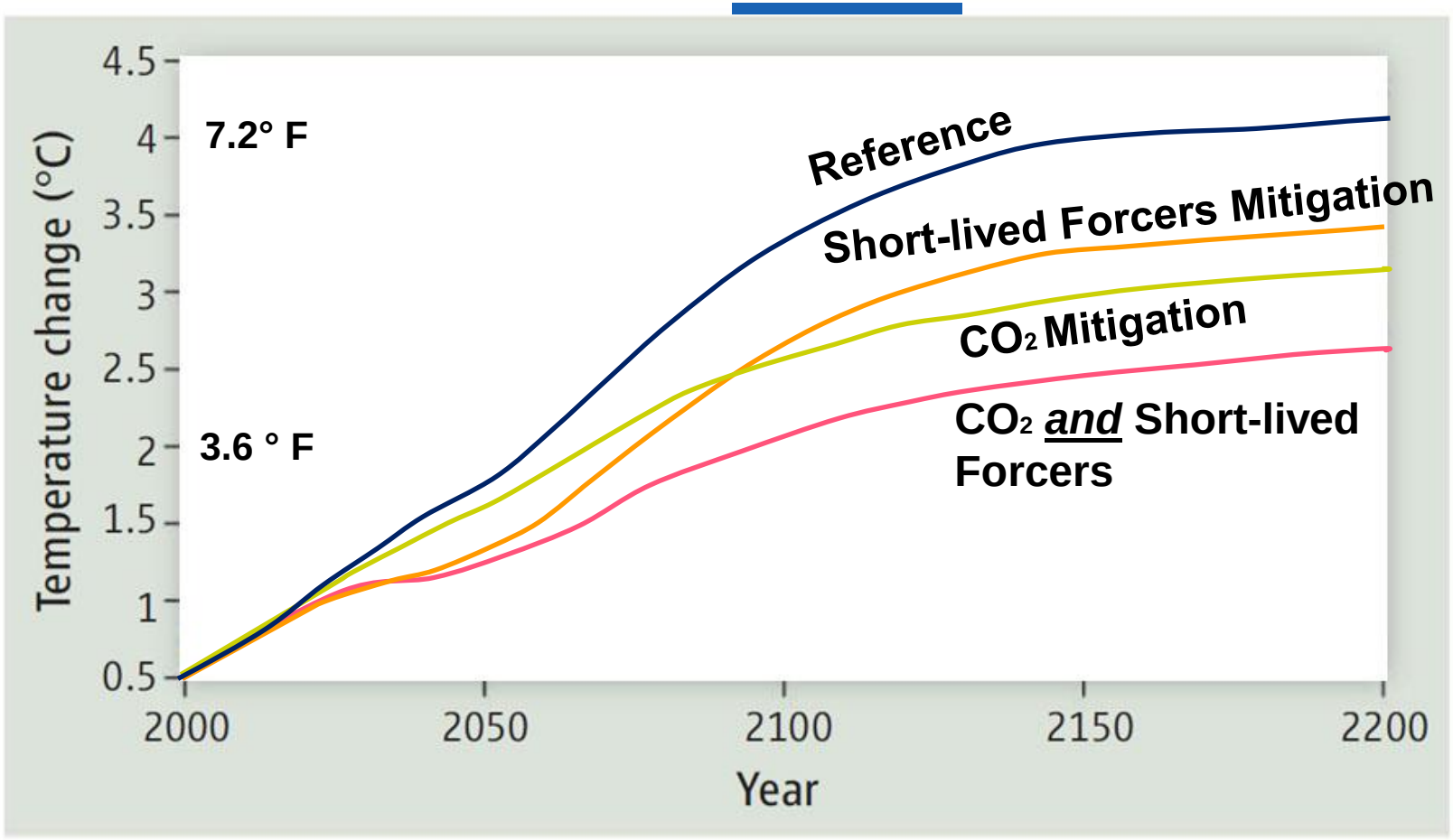
POUND FOR POUND METHANE TRAPS

84X MORE HEAT OVER 20 YEARS

CO_2

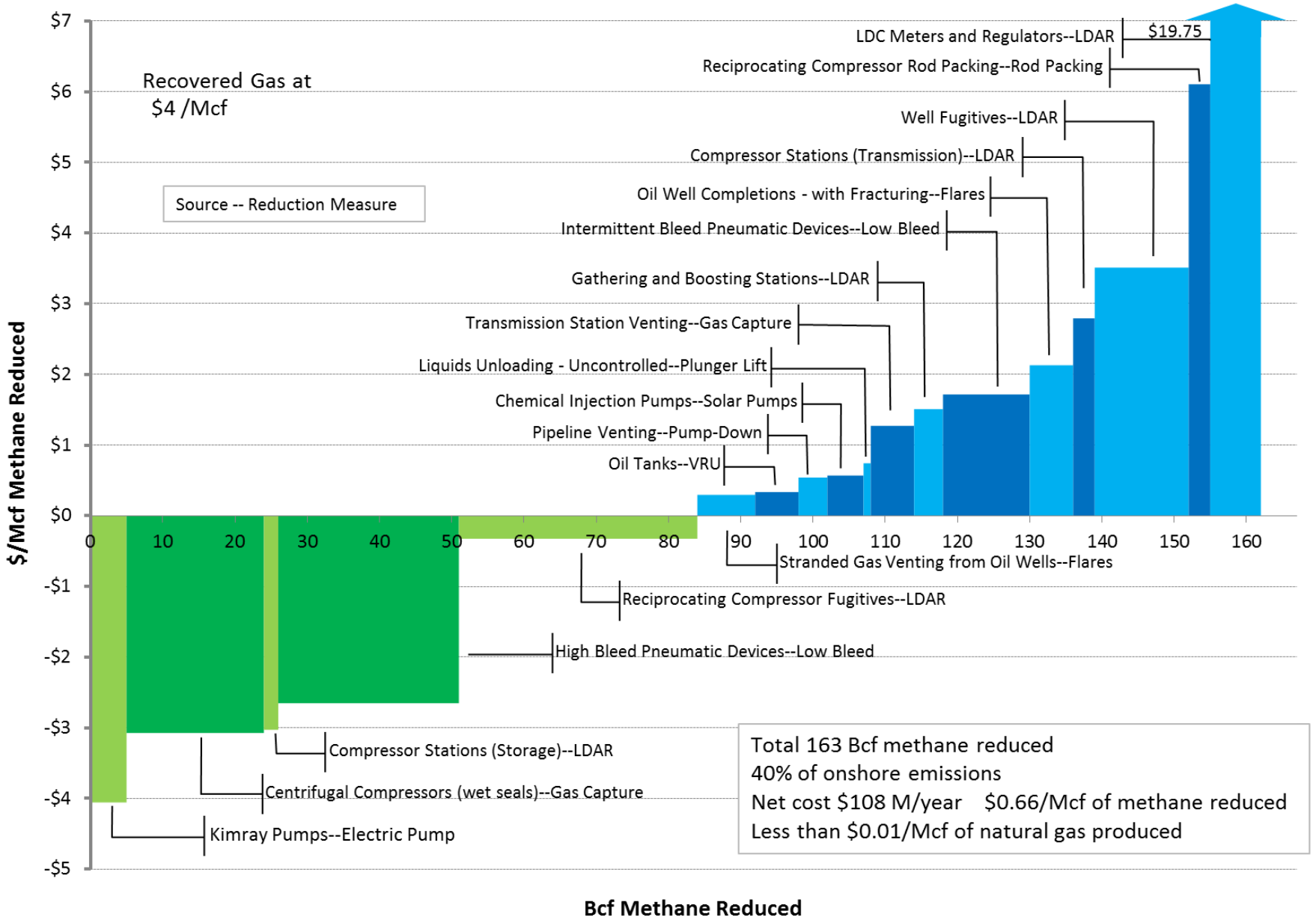
CH_4

Methane AND CO_2



About **25 percent of the man-made warming** we are experiencing today is caused by methane.

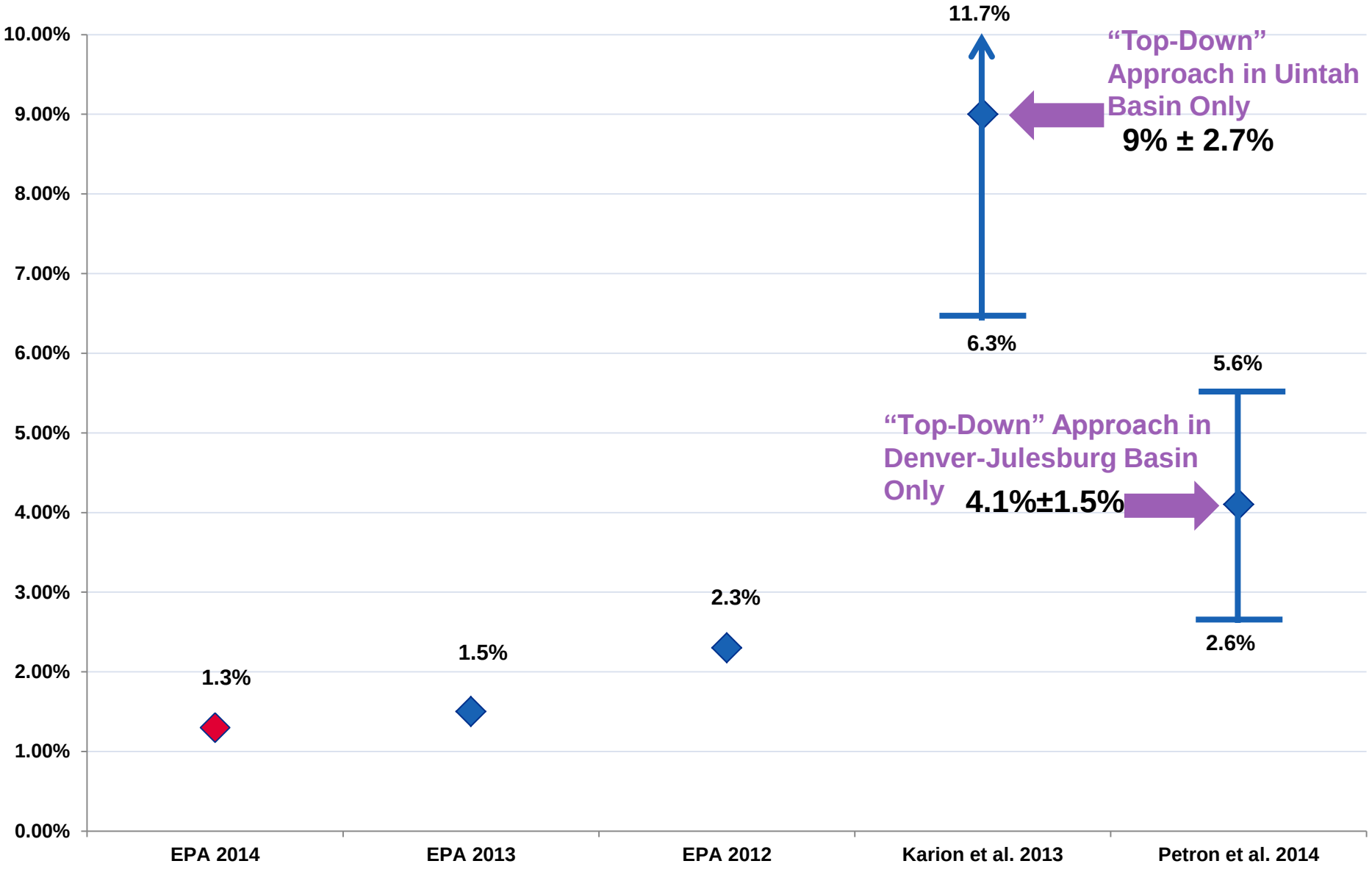
Reducing Methane is Cheap

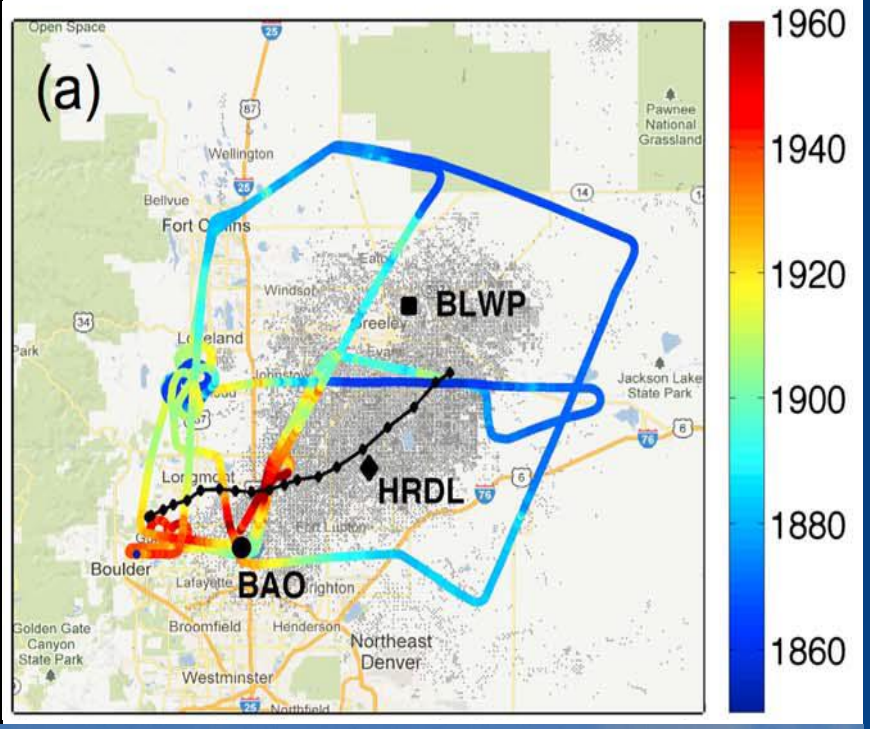


Key Take-Aways

- Methane emissions will grow between now and 2018, even with current regulations.
- 90% of emissions will come from existing infrastructure.
- With technologies already in use, methane emissions can be cut 40%.
- These reductions will only cost less than a penny per thousand cubic feet (Mcf) of gas produced.

How Much Methane do We Need to Reduce?





Different Methods Have Pros & Cons

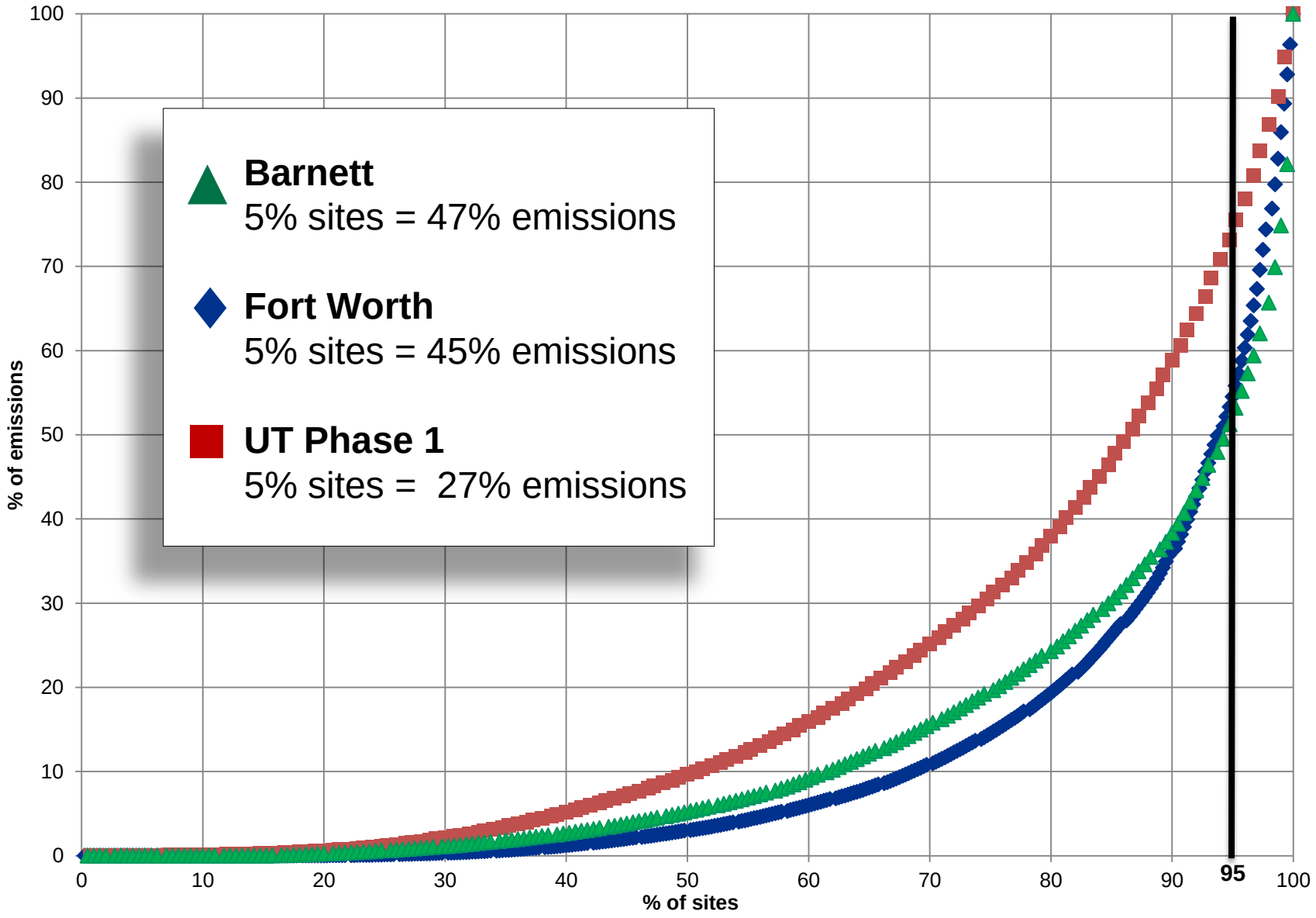
Top-Down

- Easily get data from large areas.
- Cannot easily distinguish emissions from specific sources.
- Total emissions derived by subtracting out non O&G sources
- May be biased high.

Bottom-Up

- Accurate data at the source.
- Expensive to sample large areas and can miss super-emitters.
- Total emissions derived by adding sources.
- May be biased low.

Finding Super Emitters



EDF Catalyzing More Science

16 Studies with Roughly 100 Participants

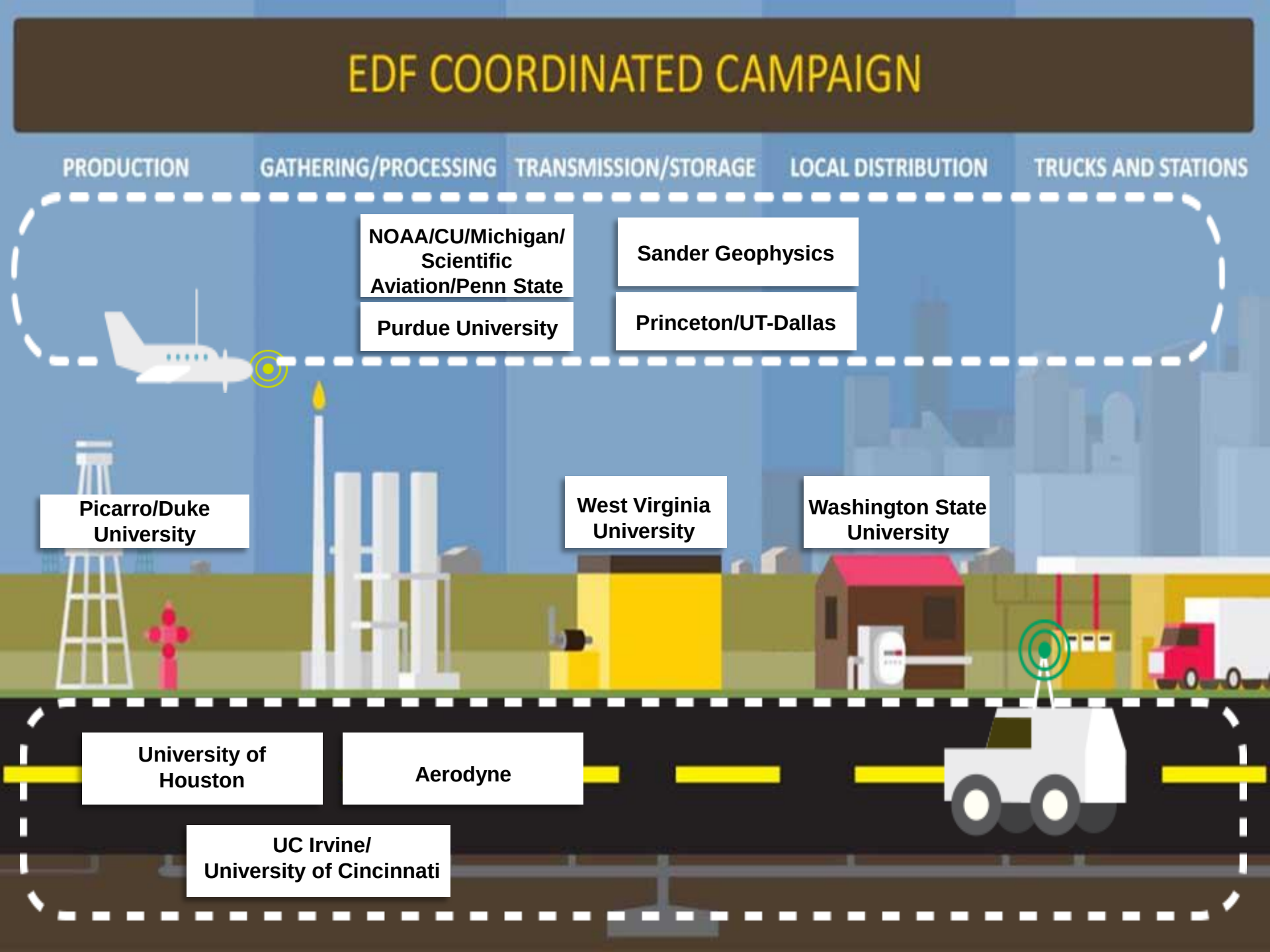
- 4 Local Distribution Studies,
- 3 Production Studies,
- 3 Top-Down Studies, and
- 6 Other Studies

3 Studies are Public:

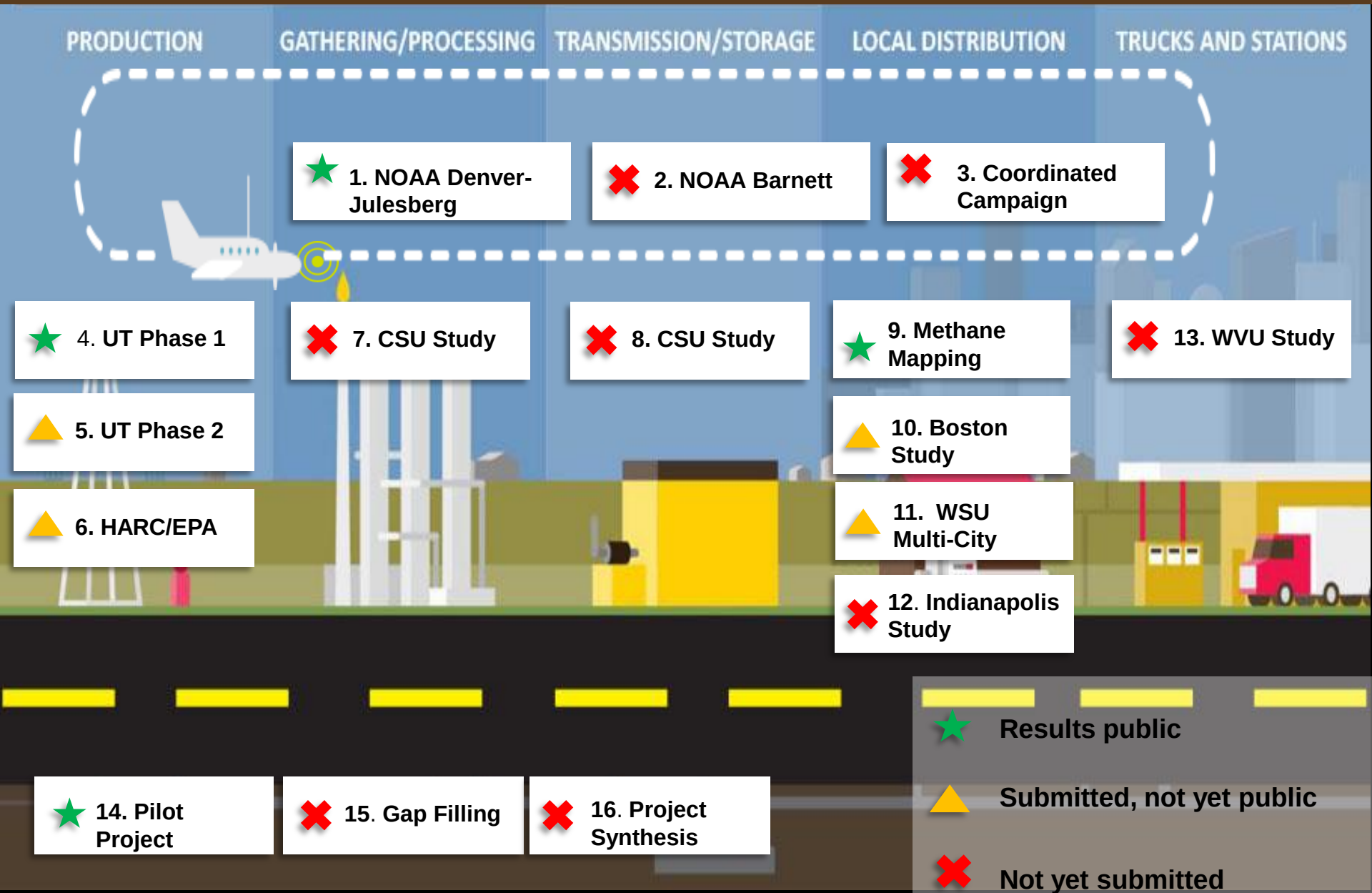
- UT Production Phase 1
http://dept.ceer.utexas.edu/methane/study/index.cfm

- NOAA-CIRES DJ Basin Study
http://onlinelibrary.wiley.com/doi/10.1002/2013JD021272/pdf

- Methane Maps
http://www.edf.org/climate/methanemaps


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/UT-Dallas
Picarro/Duke University
West Virginia University
Washington State University
University of Houston
Aerodyne
UC Irvine/ University of Cincinnati

EDF STUDIES BY SUPPLY CHAIN SEGMENT



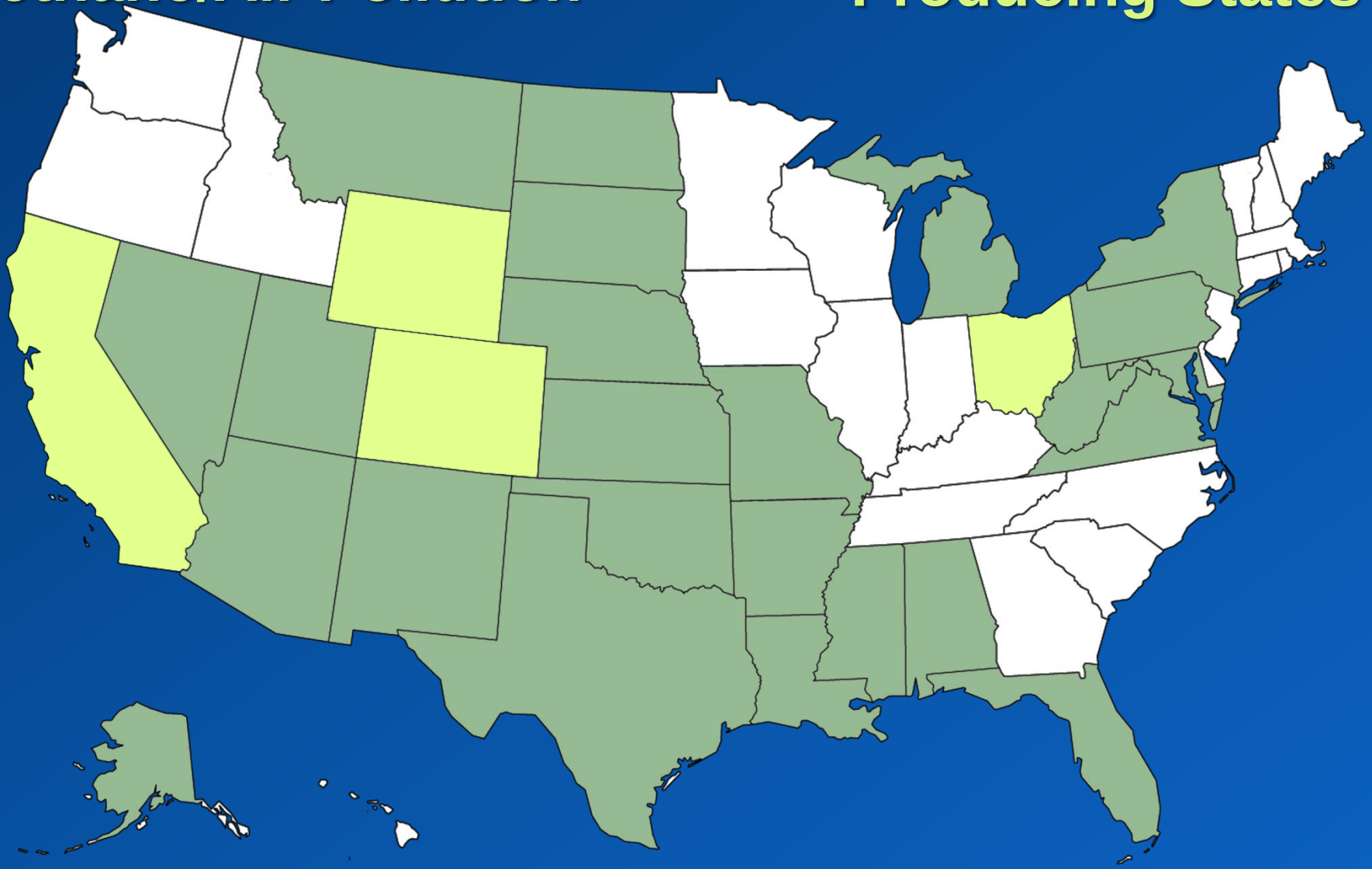
Even 1.3% Leakage is Too Much…

- **Annual GHGs of:**
  - 117 million cars *or*
  - 146 coal power plants
- Gas carried by **127 LNG tankers.**
- **$1.7- $6.2 Billion of lost revenue**

Federal Rules Necessary Too

4 States Reducing Methane/Air Pollution

28 Oil and Gas Producing States



Final Thoughts

Urgency of climate problem requires solutions that slow the rate ***and*** amount of warming.

Reducing methane reduces the rate of warming.

Industry can cost-effectively reduce methane, but not everybody is doing so.

Common-sense regulations can and should be implemented.

Reductions will provide climate ***and*** health benefits.

ADDITIONAL INFORMATION

Sources

1. **Slide 2:** Photo credit to Nicholas A. Tonelli
2. **Slide 5:** WORKING GROUP I CONTRIBUTION TO THE IPCC FIFTH ASSESSMENT N.p., 23 Sept. 2013. Web. 30 July 2014. http://www.climatechange2013.org/images/uploads/WGIAR5_WGI-12Doc2b_FinalDraft_All.pdf. Table 8.7 page 8-58.
3. **Slide 6:** Shoemaker, et. al., What Role for Short-Lived Climate Pollutants in Mitigation Policy?, Science, December 19, 2013
4. **Slide 7**: http://www.edf.org/icf-methane-cost-curve-report
5. **Slide 9**:
    - EPA Data points come from: EPA GHG inventory, 1.3% comes from 2014 US GHG inventory assuming 90% methane, 6,592 Gg CH 4.
    - Karion et al. (2013), Methane emissions estimate from airborne measurements over a western United States natural gas field, and
    - Petron et al. (2014) A new look at methane and nonmethane hydrocarbon emissions from oil and natural gas operations in the Colorado Denver-Julesburg Basin
6. **Slide 10**: Petron et al. (2014) A new look at methane and nonmethane hydrocarbon emissions from oil and natural gas operations in the Colorado Denver-Julesburg Basin
7. **Slide 11**: http://fortworthtexas.gov/gaswells/default.aspx?id=87074 and http://www.pnas.org/content/early/2013/09/10/1304880110.full.pdf+htm
8. **Slide 14**:
    - 1.3 % Leak Rate comes from US GHG inventory for Natural Gas Systems, including Associated Gas of 6,592 Gg CH4. http://epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2014-Chapter-Executive-Summary.pdf
    - $1.7 billion comes from June 2013-June 2014 avg. henry hub price ($4.31/Mmbtu) $6.2 is Japanese avg. import price June 2013-June 2014. 117 and 146 comes from EPA GHG calculator http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results and multiplying 6592 by 86/25 to get the 20 year GWP.
    - 127 LNG tankers comes from http://www.eia.gov/oiaf/servicerpt/natgas/chapter3.html where 1 tanker holds 3 bcf, using 6592 Gg.