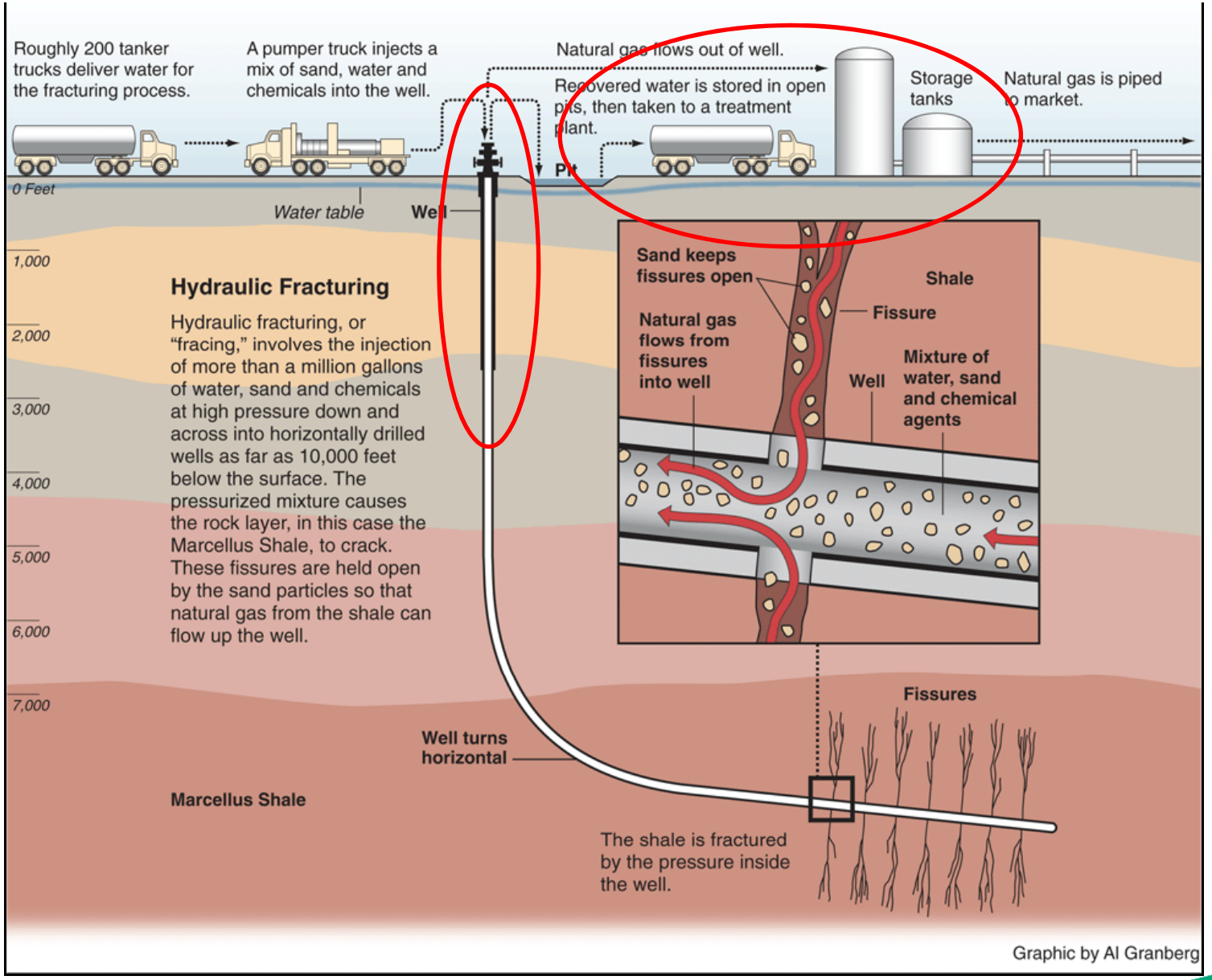
Natural Gas in a Low Carbon Future

Environmental Opportunities & Challenges

Mark Brownstein
Associate Vice President
U.S. Climate & Energy Program

EDF
ENVIRONMENTAL DEFENSE FUND
Finding the ways that work

Must address the ‘fracking’ issues



And then, there's methane…

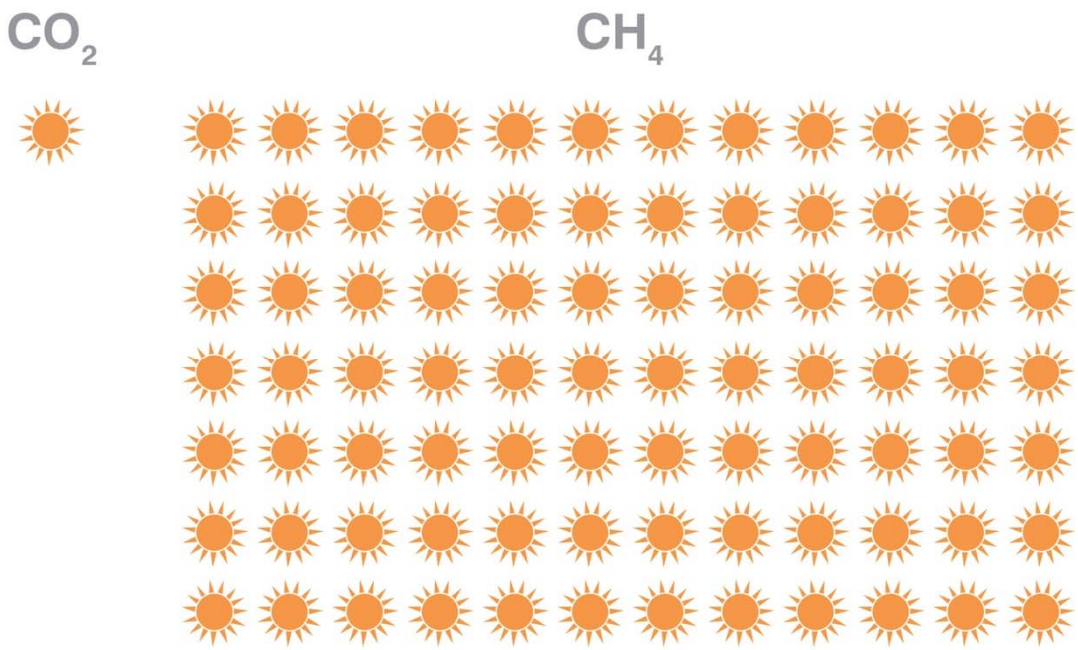
Gas storage tank

Same tank, same time, infrared camera view

…an increasingly 'visible' problem

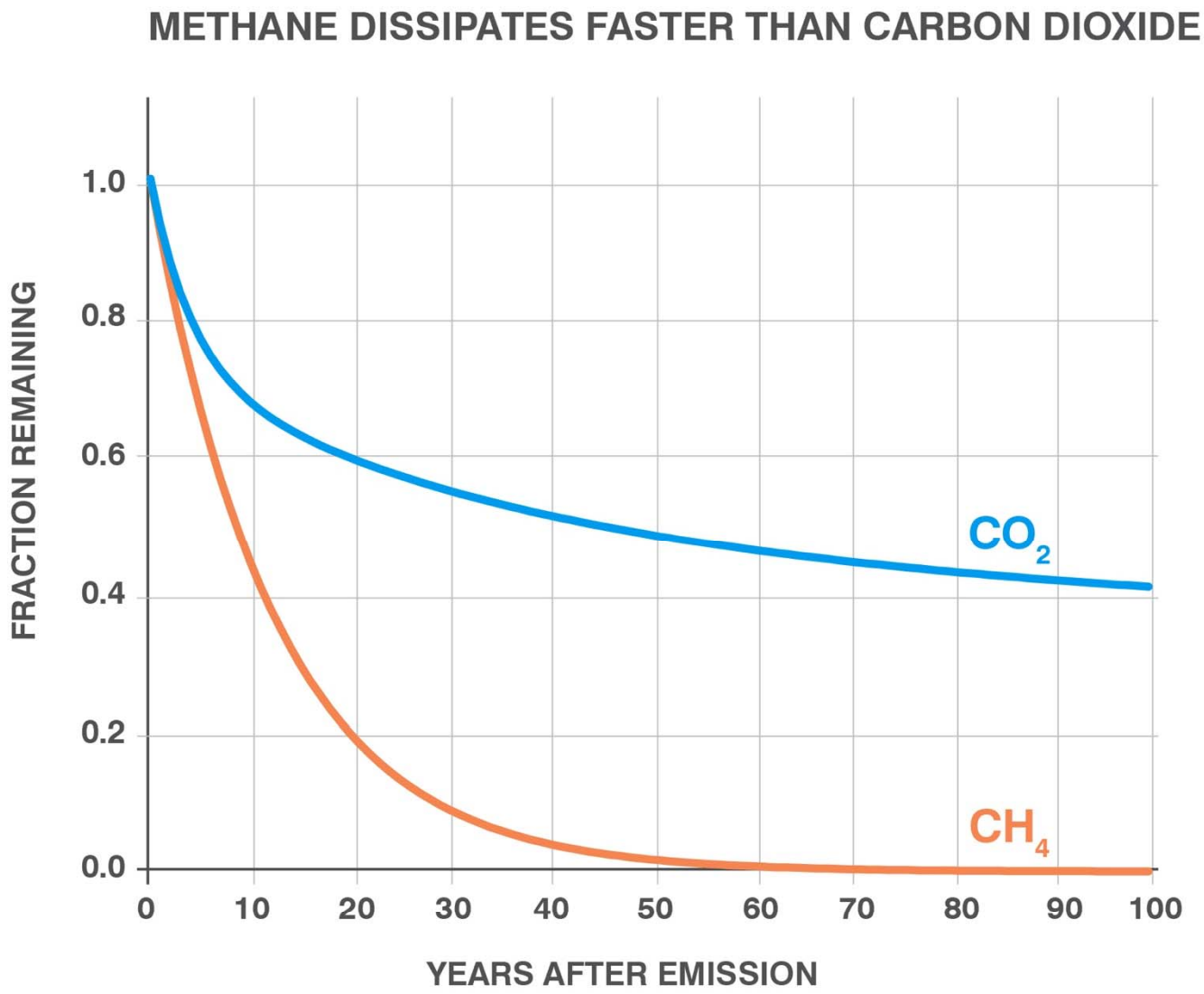
CH_4 traps more heat than CO_2...

EACH METHANE MOLECULE TRAPS **84x** MORE HEAT



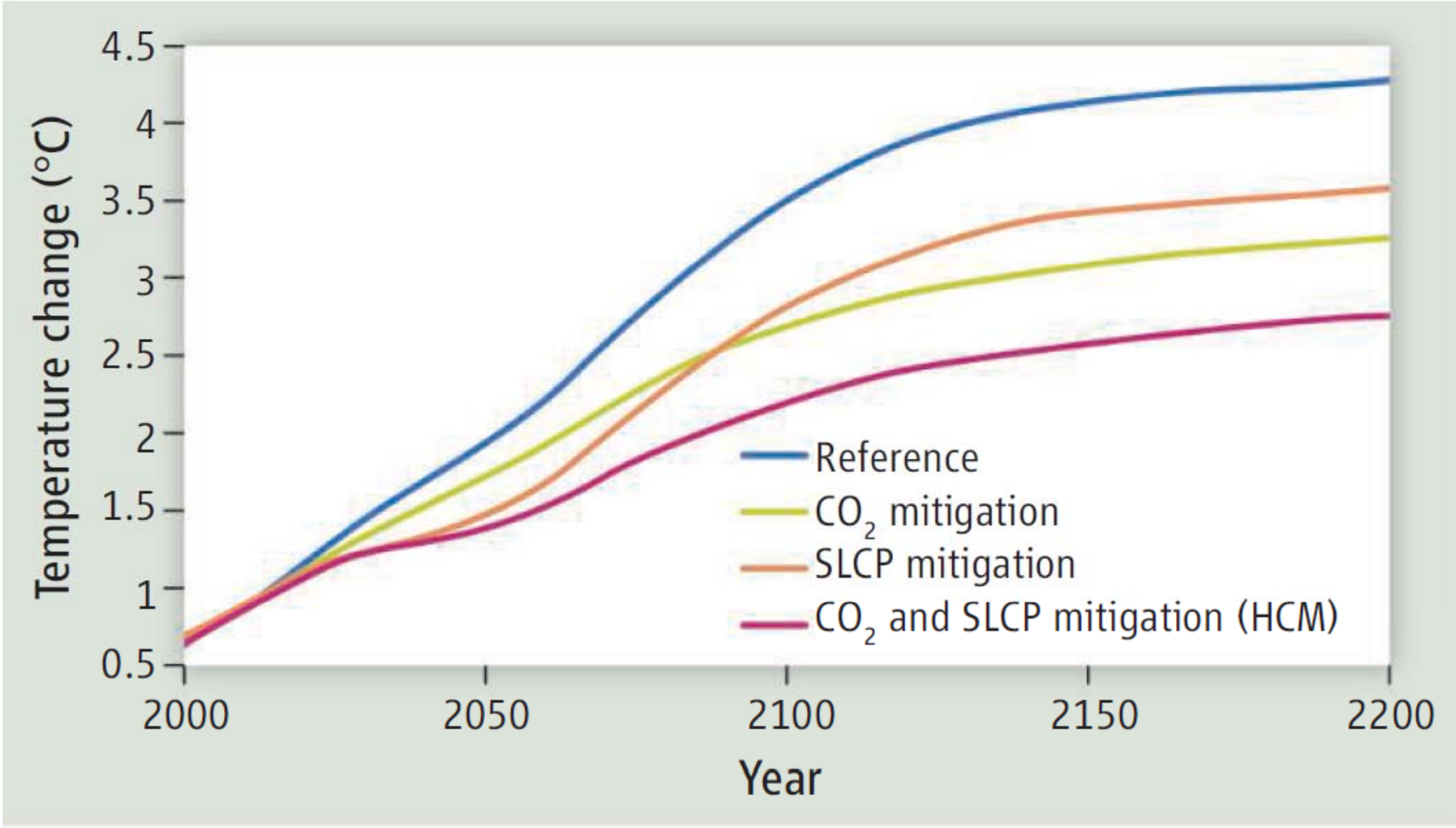
Ratio of direct radiative efficiencies, W m^{-2} ppb^{-1} (IPCC AR5)

…but breaks down faster than CO_2



- CH_4 produces tropospheric ozone and stratospheric water vapor as it decays
- Increases the direct warming effect by 65% (IPCC AR5)

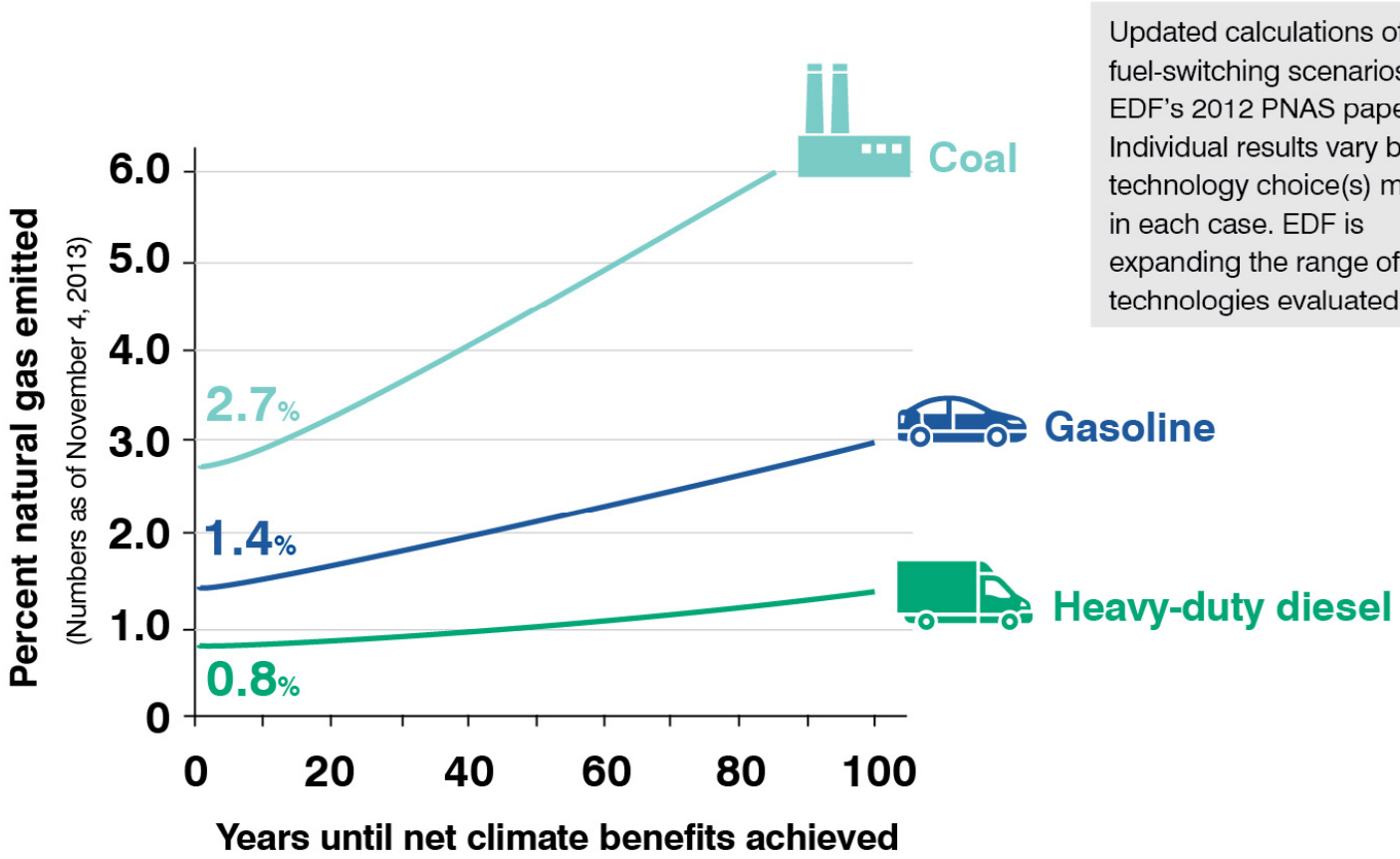
Methane *and* CO_2 reductions required



Shoemaker, et. al., **What Role for Short-Lived Climate Pollutants in Mitigation Policy?,** Science, December 19, 2013

Gas can be worse than alternatives

Depending on emission rate and timeframe



Updated calculations of fuel-switching scenarios in EDF's 2012 PNAS paper.* Individual results vary by the technology choice(s) made in each case. EDF is expanding the range of technologies evaluated.

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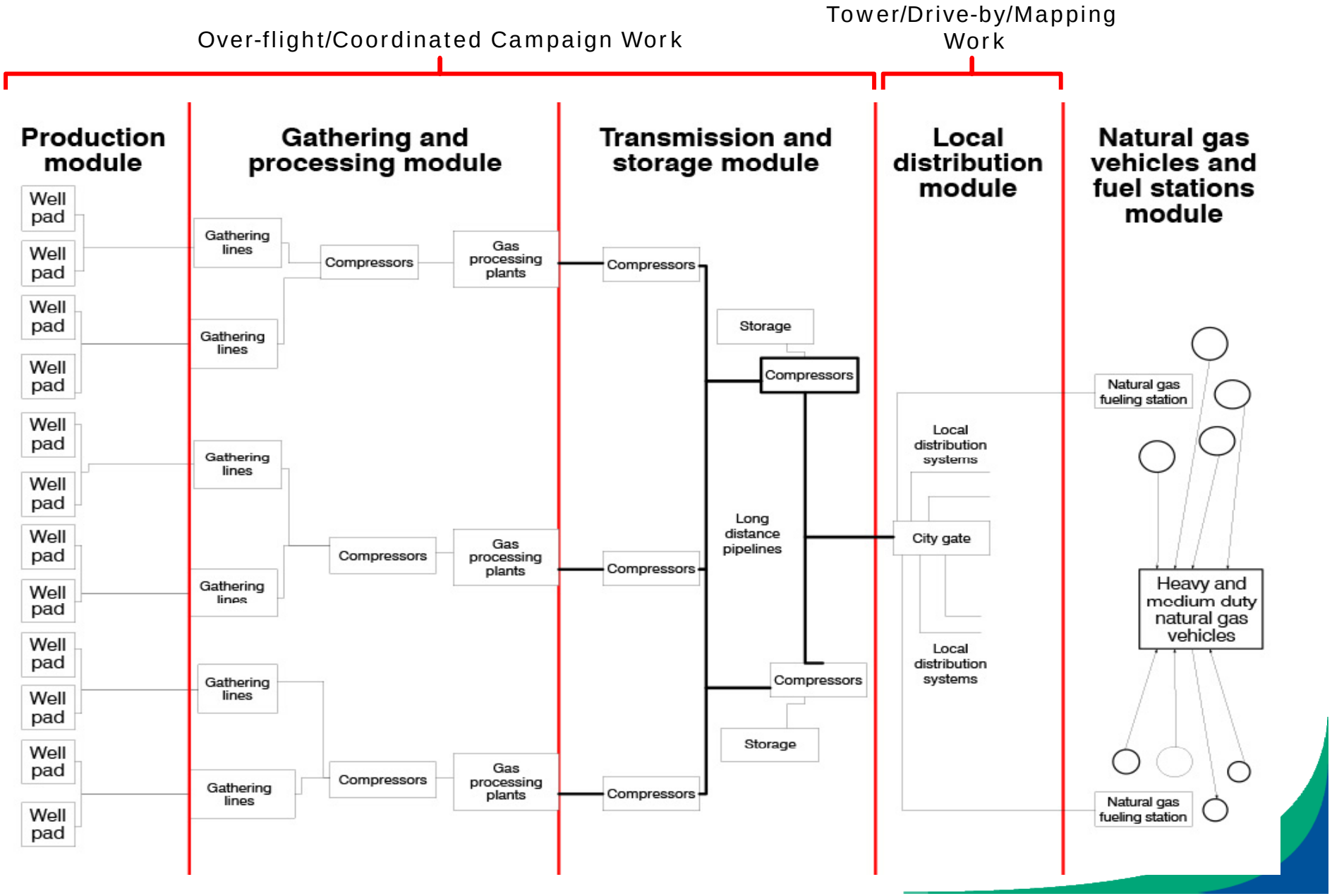
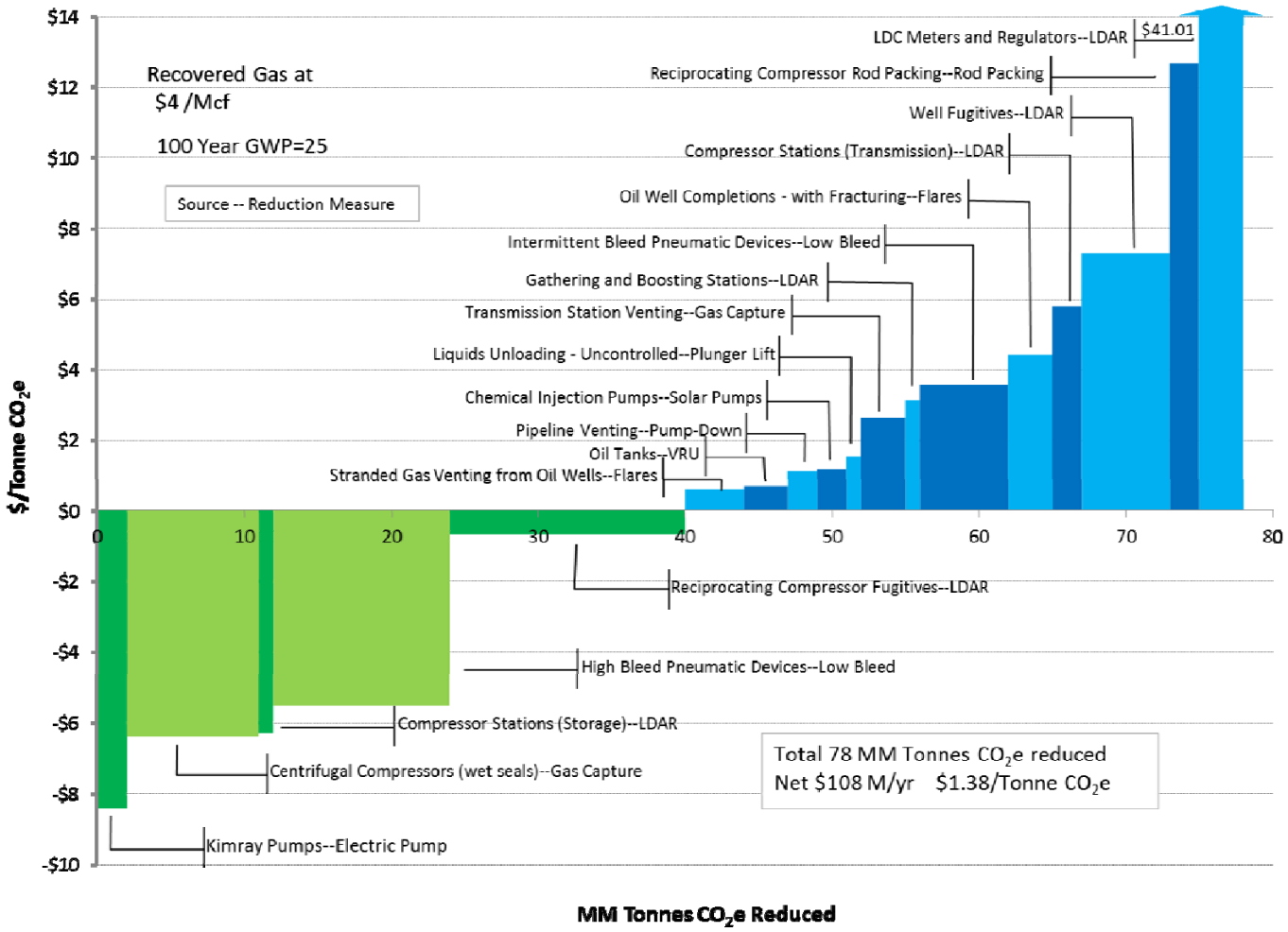
Adapted from Alvarez et al. (2012) PNAS, **109: 6435–6440, reflecting new IPCC AR5 & 2013 EPA GHG data. IPCC updates: (1) direct/indirect radiative forcing of CH_4 and CO_2, (2) CH_4 lifetime, (3) CO_2 impulse response function. Additional effects due to climate-carbon feedbacks and CO_2 from the oxidation of CH_4 not included (AR5 lacks data to support time-dependent analysis but EDF believes these effects to be small). Emissions updates include factors in Table 1 and corresponding L_{REF} values in Table S1 of PNAS paper; an L_{REF} value specific to heavy-duty CNG vehicles is now used.*

Comprehensive emission study effort



Highly cost-effective reductions

http://www.edf.org/icf-methane-cost-curve-report



Economic Analysis of Methane Emission Reduction Opportunities in the U.S. Onshore Oil and Natural Gas Industries
ICF International, March 2014,