CALIFORNIA ENERGY COMMISSION RESEARCH ON METHANE EMISSIONS FROM THE NATURAL GAS SYSTEM

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Outline

- Basic background information
- Description of past and on-going research supported by the Energy Commission
- Energy policy relevant issues identified in the 2014 Update to the Integrated Energy Policy Report (IEPR).
- Some observations about the 2015 IEPR

Acknowledgment

- Dr. Marc Fischer (LBNL/UC Davis) provided slides 9 and 10 that were modified by Mr. Franco to avoid reporting confidential **preliminary** results for on-going research supported by the Energy Commission. Kristen Driskell and Karen Griffin provided very useful comments to an earlier version of this presentation.

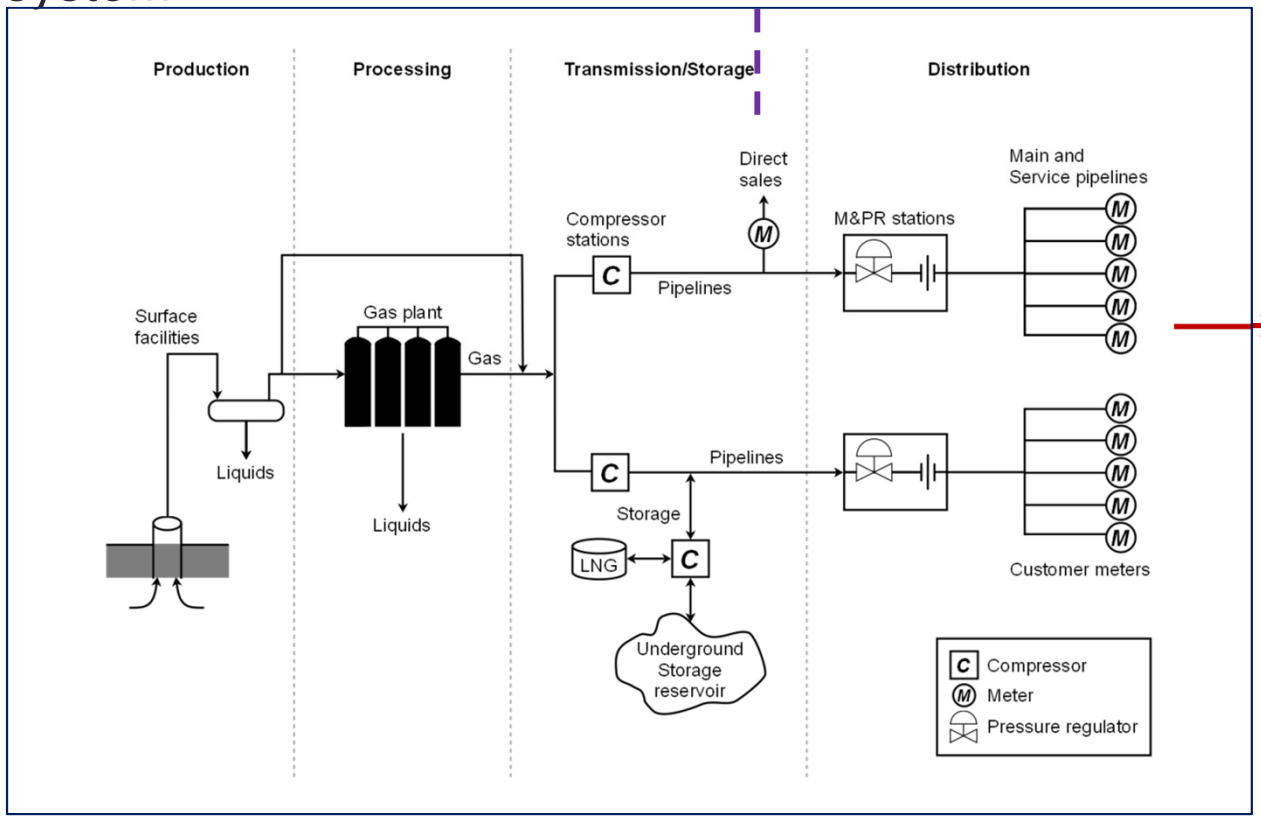
Background

Emissions Attributed to a Given End Use Consumption Should Include All Upstream Losses

Source: Diagram from an EPA Report taken via "Natural Gas & Climate Change." Eric Larson. Climate Central. 2013

Power plants: Most power plants are directly connected to transmission lines. Downstream emissions should not be attributed to these plants

NG system



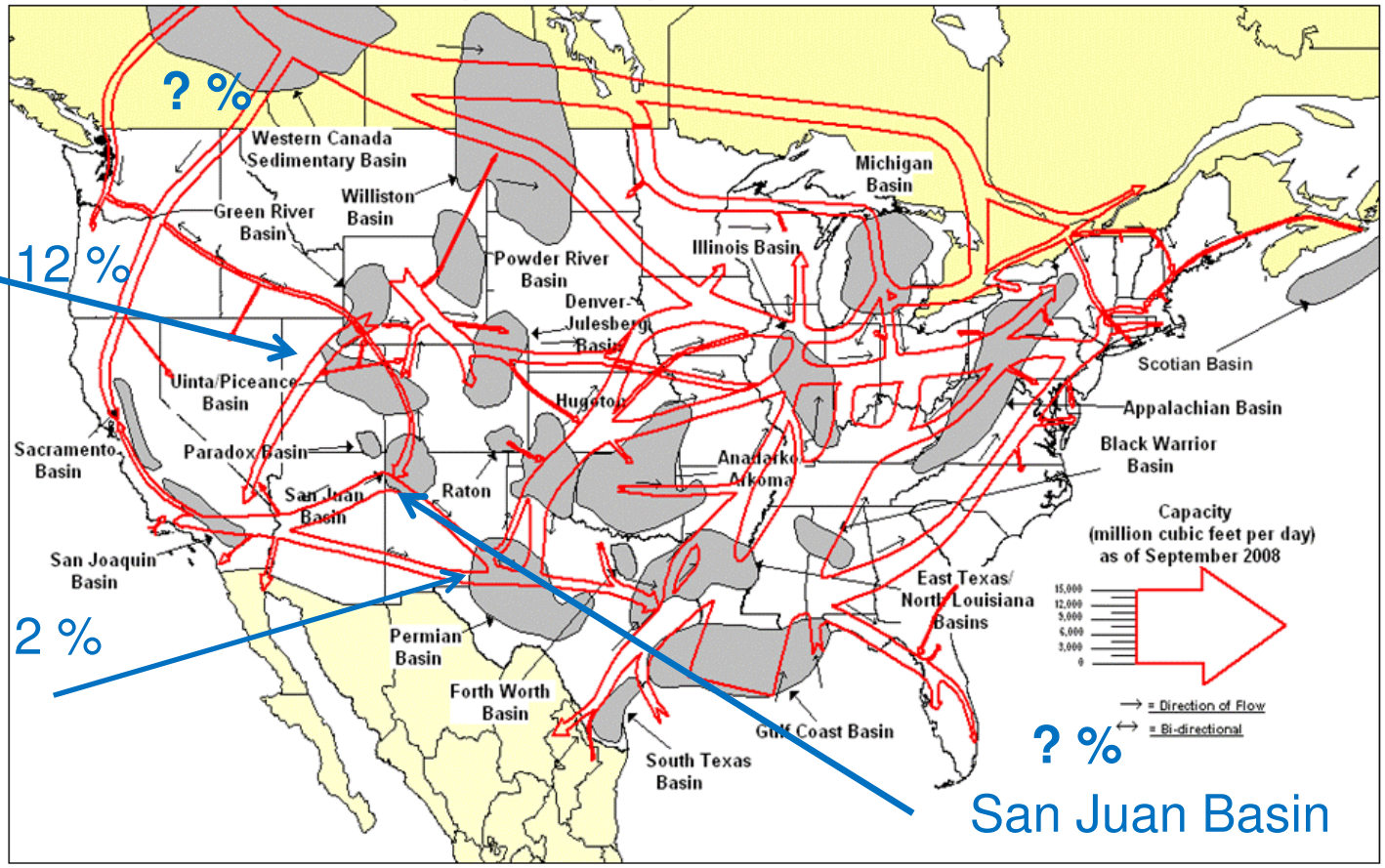
The "NG system" on the left is incomplete. It should include end users downstream of the meters (e.g., homes)

It is extremely important to properly apportion all losses

More than 90% of natural gas supply imported into California

- Imports to California
  (% of total consumption in 2012)
  - Canada 16%
  - Southwest 35%
  - Rocky Mountains 40%
- Blue numbers = "measured" leak rates as % of production
- From Alvarez et al., PNAS 2012
  - For natural gas (CNG) to immediately reduce climate impacts from heavy-duty vehicles, well-to-wheels leakage must be reduced below **1%**
  - New natural gas power plants produce net climate benefits relative to efficient, new coal plants using **3.2%** from well through delivery at a power plant

U.S. Natural Gas Supply Basins Relative to Major Natural Gas Pipeline Transportation Corridors, 2008



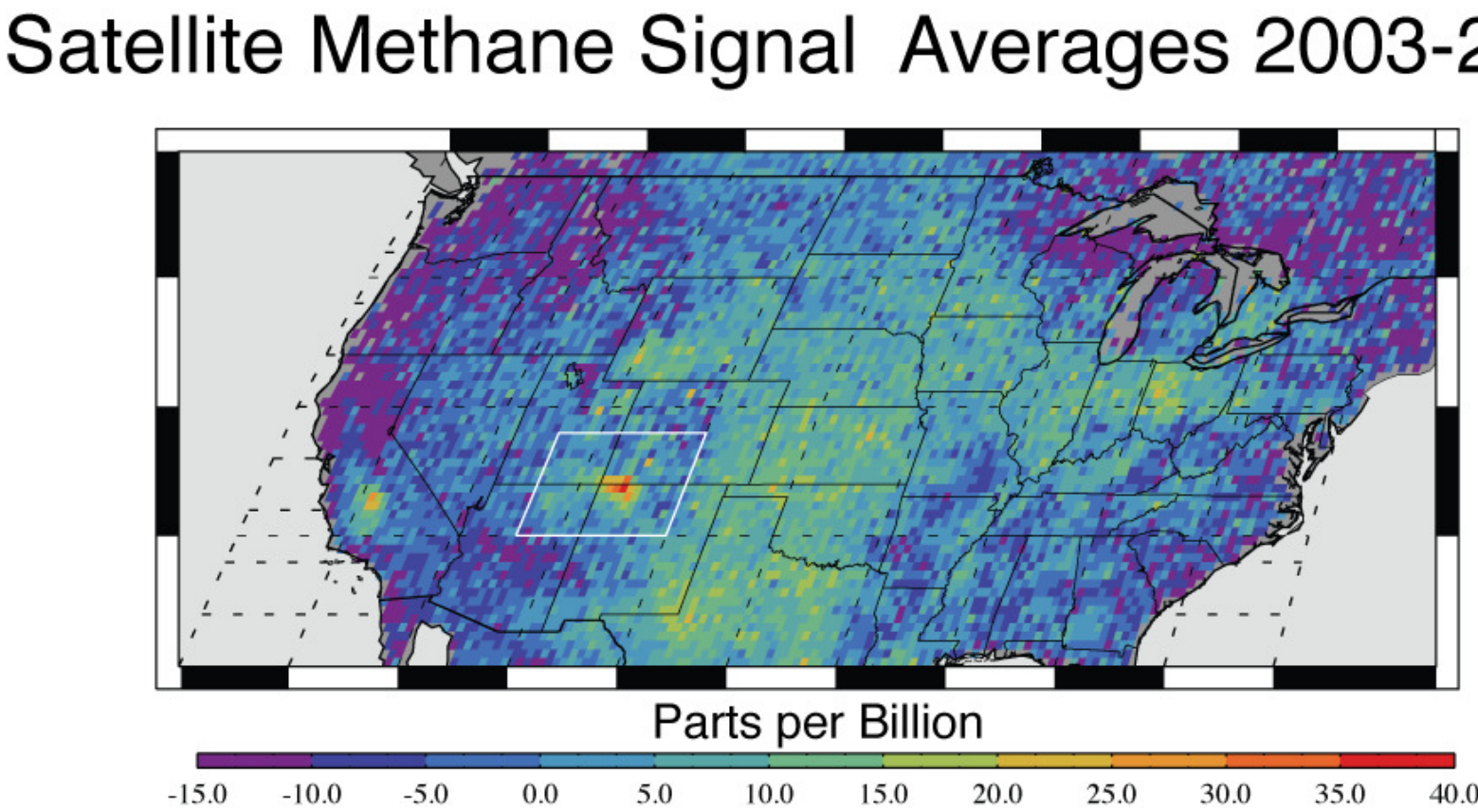
Source: Energy Information Administration, Office of Oil and Gas, Natural Gas Division, GasTran Gas Transportation Information System.

The EIA has determined that the informational map displays here do not raise security concerns, based on the application of the Federal Geographic Data Committee's *Guidelines for Providing Appropriate Access to Geospatial Data in Response to Security Concerns*.

Percentages come from a February 18, 2015, AGU news release

San Juan Basin

- "Satellite data shows U.S. methane 'hot spot' bigger than expected" AGU 9 October 2014.



Kort, E. A., et al., 2014. Four Corners: the largest US methane anomaly viewed from space. GRL. Vol 41 Issue 19

Past and on-going research supported by the Energy Commission

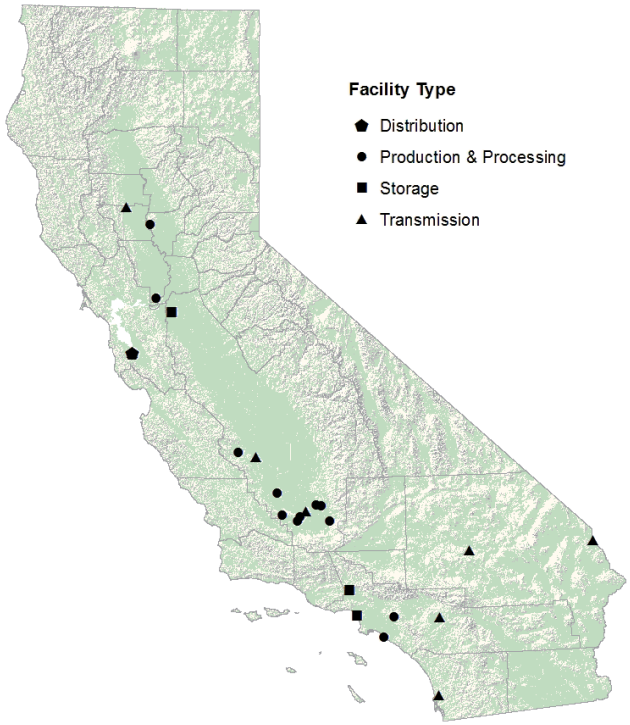
CEC started monitoring GHG in ambient air in 2005

- CALGEM project with LBNL demonstrated that methane and nitrous oxide emissions were most likely substantially higher than reported in the ARB inventory
- ARB and others are leading this effort now with additional measurement sites and new approaches

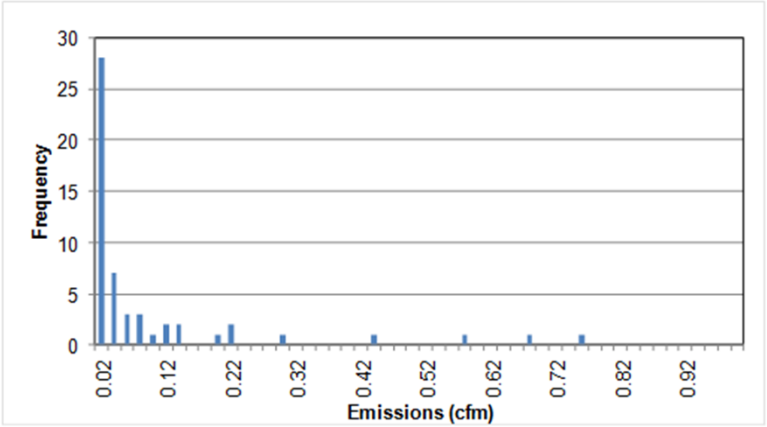
Source: CALGEM

Project with Fullerton State University

- Bottom-up field campaign (~2010) measuring emissions from thousands of different units representing different components (e.g., flanges)
- Most of the emissions come from “super-emitters”
- Similar results have been reported by others more recently
- “Super-emitters” can create huge problems for GHG inventories and for mitigation programs. A different approach is needed.

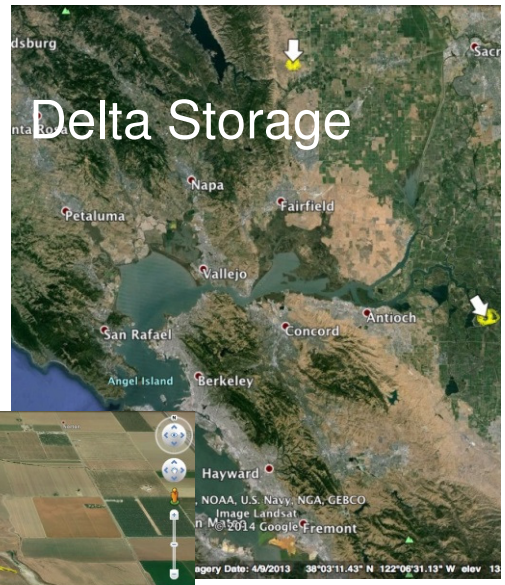


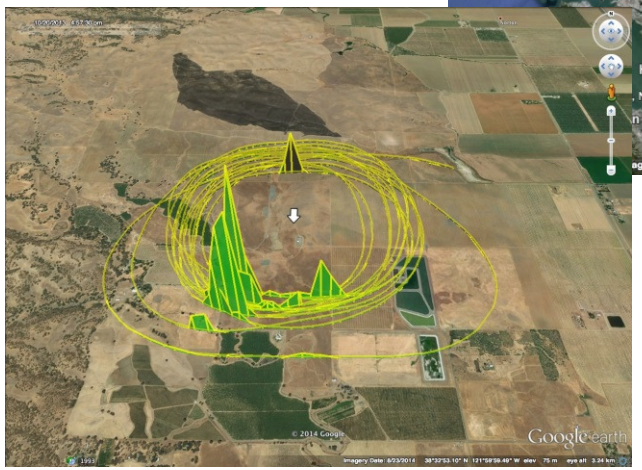
Leak-Rate Histogram of Flanges



On-going CEC research

- Holistic assessment to determine the main source of emissions (e.g., distribution network, wells) from the natural gas system (LBNL/UC Davis)
- Evaluation of opportunities to reduce methane emissions (LBNL)
- Using an airplane with a monitor for methane and ethane to detect leaks in remote locations
- Methane emissions from the residential sector (some measurements in Southern CA)
- Work done in coordination with ARB, NASA, NOAA, Utilities, and others.



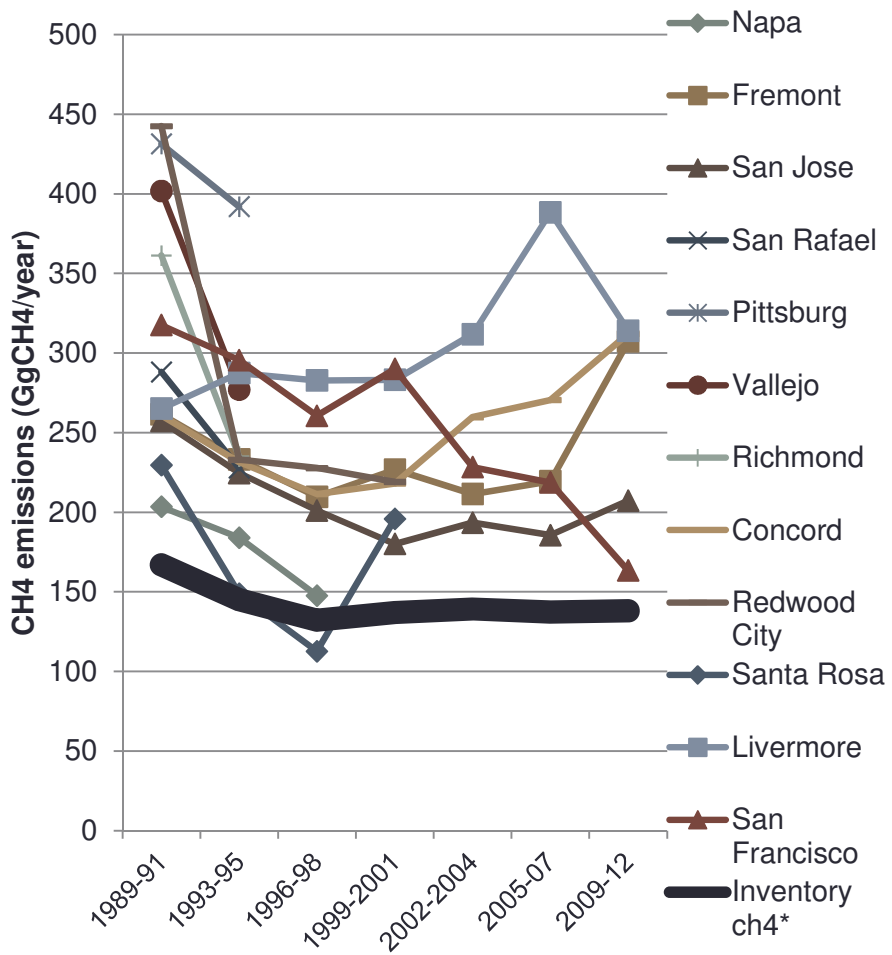


SSJV Production

Source: CEC project with LBNL/UC Davis

SF Bay Area Emissions

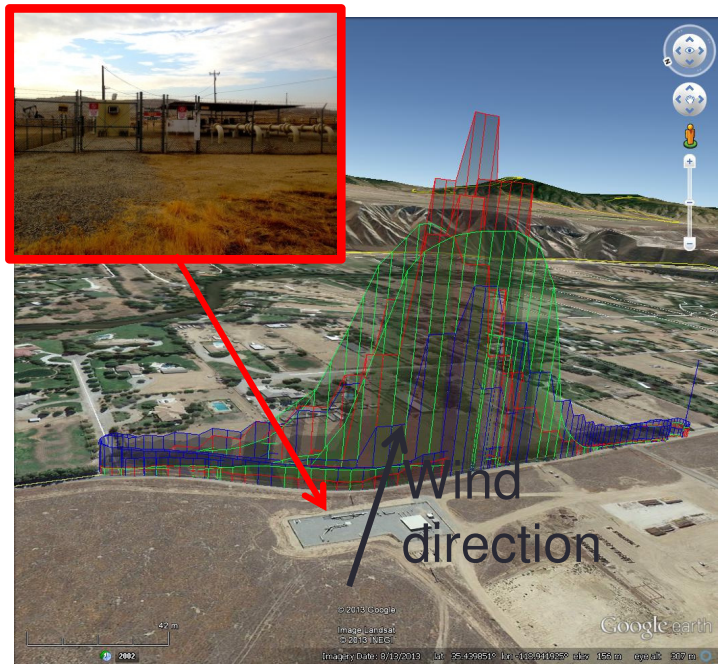
- Estimate CH_4 emissions CH_4:CO correlations + CO emission inventory
  - Total CH_4 1.5 – 2.0 x BAAQMD Inventory
  - AQ focused sites likely biased toward CO emissions
- Future: expand w/ VOC tracers to quantify NG emissions from distribution

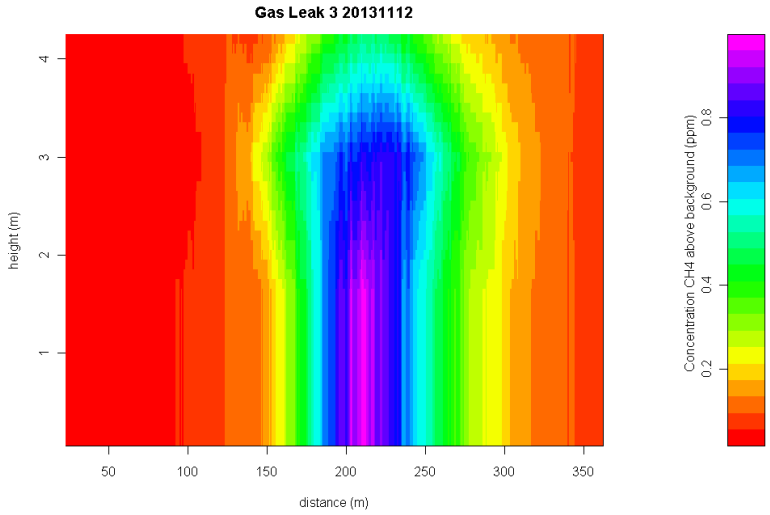


Source: Fairley, D., Fischer, M.L., Top-Down Methane Emissions Estimates for the San Francisco Bay Area from 1990 to 2012, *Atmospheric Environment* (2015), doi: 10.1016/j.atmosenv.2015.01.065.

Local Measurements: LBNL Mobile Plume Integration System

- Cross-wind integral of CH_4 enhancement flux quantifies plume emissions
  - Samples to 8 magl
  - Multi-analyzer system (w/ 13C)
  - Anemometry for mean winds & turbulence
- Recent system developments
  - Tests at LBNL and PG&E test facilities show ability to capture plumes
  - Test measurements show capability to capture unknown emissions

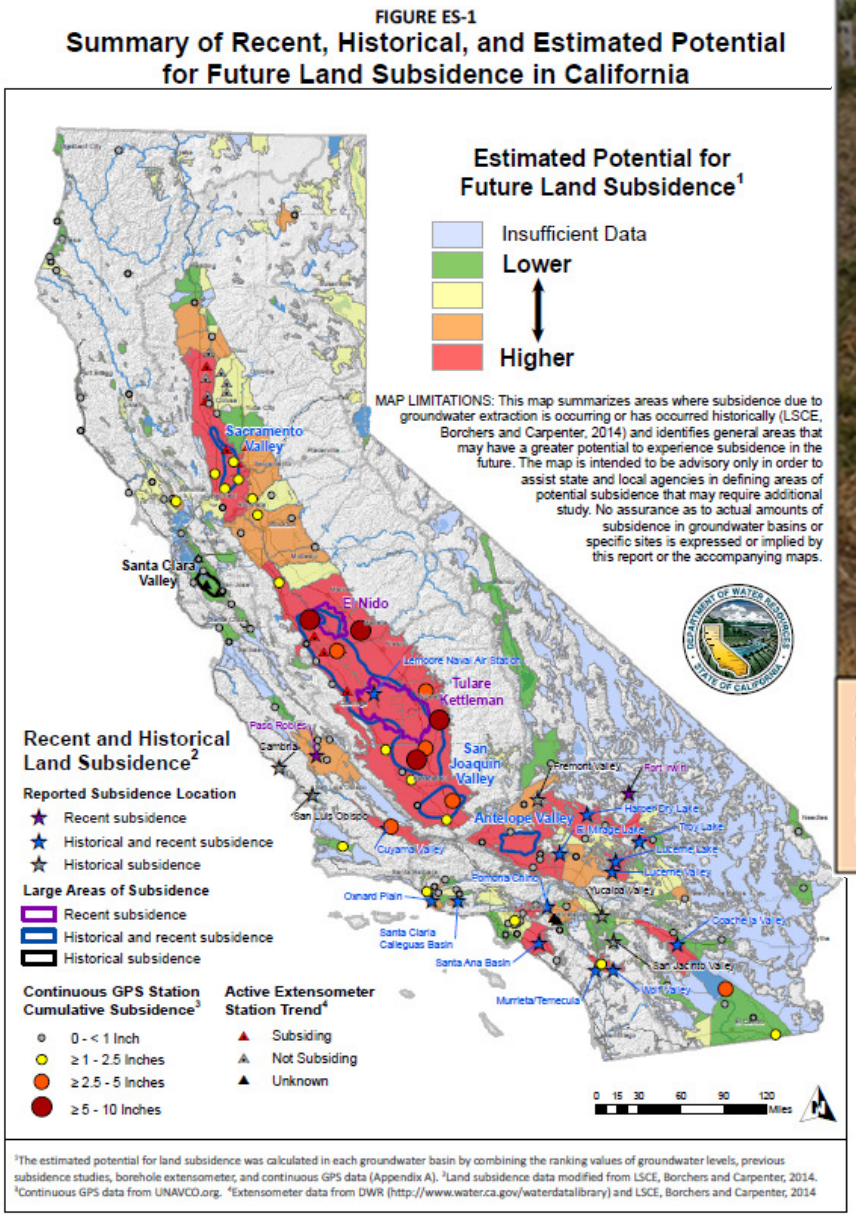




Source: CEC project with LBNL

Subsidence

- The drought is severely increasing land subsidence
- Is subsidence in the Central Valley degrading the physical integrity of abandoned wells? We don't know
- LBNL is conducting some exploratory measurements



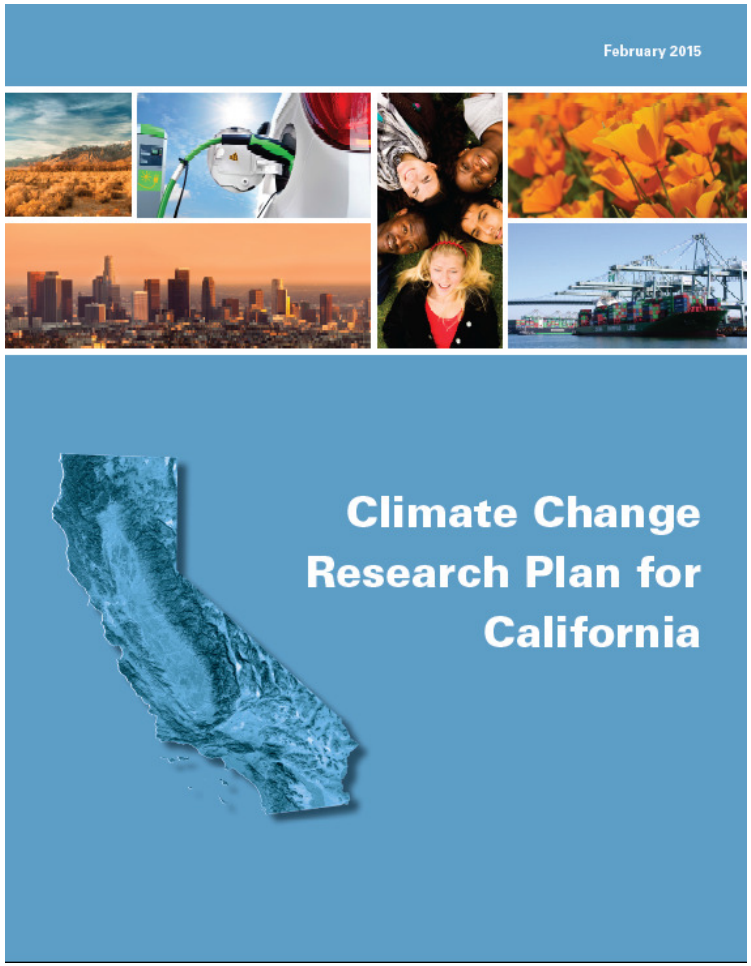
Source: DWR 2014

2 year old well (drilled 2010). Land surface shows 2 feet of subsidence (well location shown on map). Photo courtesy Sarge Green, California Water Institute.

Protruded Well

Future CEC Projects

February 2015



CEC studies that will start in the near future [request for proposals late this year]

- Estimating emissions from buildings, power plants, industrial facilities (downstream of the meters)
- More in-depth studies (e.g., abandoned wells). The results of the on-going studies will determine the course to take. Preliminary results are percolating and most of the work will be done by late this summer
- Options to reduce methane emissions

Integrated Energy Policy Report (IEPR)

2014 Integrated Energy Policy Report Update

- Super emitters create huge challenges for bottom-up inventories because it almost requires testing all components of the natural gas system to ensure that all super emitters are identified
- Emissions can be sporadic, and testing done at discrete times may or may not capture these emissions
- Emissions estimates for California exclude emissions that occur at fuel stages, such as extraction and fuel processing, that take place outside the state. From an energy policy perspective, however, all emissions from “well-to-wheel” are important.
- Some studies report emissions from associated gas (gas from wells that produce both crude oil and natural gas) as being part of the natural gas system. How to apportion these emissions?

2015 Integrated Energy Policy Report

- The Energy Commission will continue to develop the report required by Assembly Bill 1257 (Bocanegra, Chapter 749, Statues of 2013) as part of the 2015 IEPR.
- The AB 1257 report will include an assessment of the benefits and environmental impacts of natural gas as an energy source for both electricity, transportation, and residential use.
- To develop the information necessary for this report, the Energy Commission will hold public IEPR workshops to assess the state of the science on methane emissions from the natural gas system.

Thank you!

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