Methane Pollution and Reductions from Oil & Gas Operations

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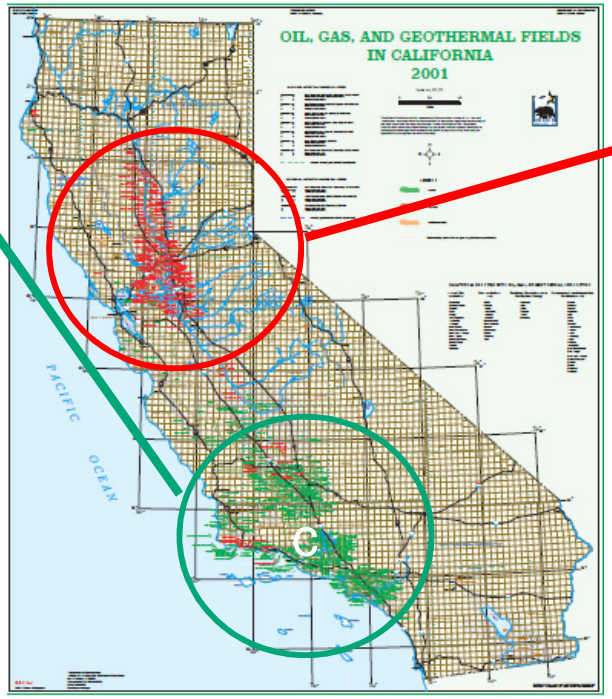
Finding the ways that work

California Oil and Gas Background

Crude Oil

- 3rd largest oil producing state
- About 50,000 wells
- Produces about 50% of oil used in state



Natural Gas

- About 1,350 producing wells
- About 370 storage wells
- Produces about 10% of gas used in state

Methane challenge

- Oil and gas production is an industrial process
- Largest industrial source of methane in the U.S. and California
- Large source of VOC, HAP as well
  - 14% of U.S. VOC emissions – smog forming gas
  - ~57,000 metric tons of HAP – toxic air pollutant
- Several studies suggest larger actual emissions than prior estimates

CARB inventory = > 7.7 million pieces of equipment in oil and gas production in CA

Methane challenge

7.7 million + pieces of equipment in California require vigilance and in some cases - redesign

- Connectors
- Threaded Components
- Manual Valves
- Flanges
- Compressor Seals
- Polished Rod Stuffing
- Pressure Relief Valves
- Meters
- Open-ended Lines
- Pump Seals
- Hatches
- Sight Glasses
- Diaphragms
- Dump Lever Arm
- Wells cellars
- Well heads
- Sumps
- Loading Arms
- Continuous Bleed Controllers
- Intermittent Bleed Controllers
- Low Bleed Controllers
- Piston Valve Operator
- Hydraulic Valve Operator
- Automated Control Devices
- Compressor Blowdowns
- Natural Gas Gathering
- Sweetening/Acid Gas Removal
- Well Workovers
- Dehydrators
- Well Cleanups
- Compressor Startups
- Carbon Adsorbers
- Storage Tank Operation
- Storage Tank Degassing
- Separator Degassing
- New Wells Drilled

Even 1.3% is Too Much

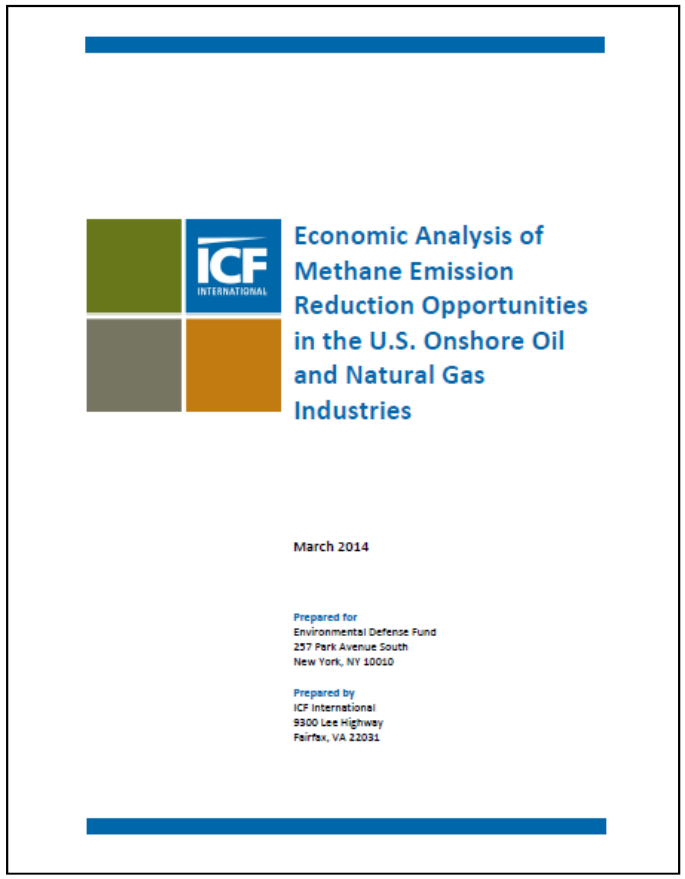
Nationally, a 1.3% Leak Rate =

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

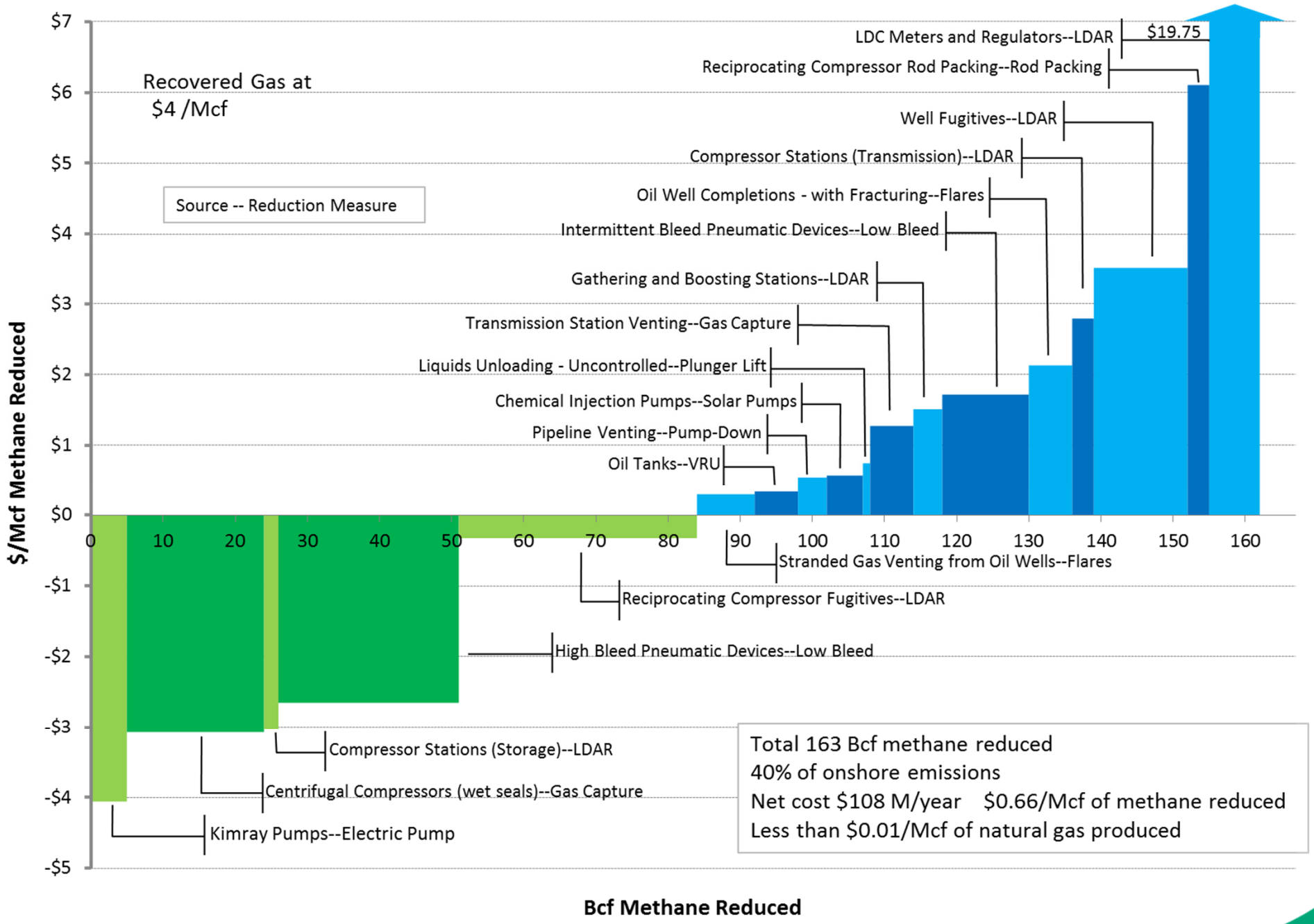
Sources: 1.3 % Leak Rate comes from US GHG inventory for Natural Gas Systems, including Associated Gas of 6,592 Gg CH4. *http://epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2014-Chapter-Executive-Summary.pdf*
$1.7 billion comes from June 2013-June 2014 avg. henry hub price ($4.31/Mmbtu) $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.

ICF Consulting Methane Cost Curve Report (March 2014)

Cost-effective solutions exist for oil and gas industry to reduce methane emissions



Methane Reductions are Cost-Effective



Total 163 Bcf methane reduced
40% of onshore emissions
Net cost $108 M/year $0.66/Mcf of methane reduced
Less than $0.01/Mcf of natural gas produced

Methane reduction opportunity

- With technologies already in use, **methane emissions can be cut 40%** from onshore oil and gas sources.
- These reductions are achievable at **a net cost of less than a penny per thousand cubic feet (Mcf) of gas produced**.
- Some **emission controls pay for themselves**.

Regulatory Action on Oil and Gas Operations

Federal

- Regulations on new or modified sources after Aug. 2011 – aimed at VOC reductions with methane co-benefits
- 2015 Obama federal goal of 45% reduction of methane – new regulations this summer

State and Local

- Some existing LDAR and inspection and maintenance regulations at district level for VOC control
- Proposed new regulations (2015) that set source based I&M requirements and comprehensive LDAR under AB 32

Expected Reductions from CARB 2015 O&G regulation

Proposed Category for Control	Reductions (tonnes CO_2e)
Uncontrolled Oil and Water Separators and Tanks	252,000
Reciprocating Compressors	143,000
Centrifugal Compressors	10,700
Pneumatic Devices and Pumps	124,000
Recirculation Tanks for Well Stimulation	24,400
Liquids Unloading	350
Components under New LDAR Program	1,200
TOTAL	**556,000**

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