Methane Pollution and Reductions from Oil & Gas Operations

Timothy O’Connor
Director, California Climate Initiative

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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.
$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/servicerept/natgas/chapter3.html where 1 tanker holds 3 bcf, using 6592 Gg.
Cost-effective solutions exist for oil and gas industry to reduce methane emissions
Methane Reductions are Cost-Effective

- Recovered Gas at $4/Mcf

Source -- Reduction Measure

- LDC Meters and Regulators--LDAR $19.75
- Reciprocating Compressor Rod Packing--Rod Packing
- Well Fugitives--LDAR
- Compressor Stations (Transmission)--LDAR
- Oil Well Completions - with Fracturing--Flares
- Intermittent Bleed Pneumatic Devices--Low Bleed
- Gathering and Boosting Stations--LDAR
- Transmission Station Venting--Gas Capture
- Liquids Unloading - Uncontrolled--Plunger Lift
- Chemical Injection Pumps--Solar Pumps
- Pipeline Venting--Pump-Down
- Oil Tanks--VRU
- Stranded Gas Venting from Oil Wells--Flares
- Reciprocating Compressor Fugitives--LDAR
- High Bleed Pneumatic Devices--Low Bleed

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

<table>
<thead>
<tr>
<th>Proposed Category for Control</th>
<th>Reductions (tonnes CO$_2$e)</th>
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<tbody>
<tr>
<td>Uncontrolled Oil and Water Separators and Tanks</td>
<td>252,000</td>
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<tr>
<td>Reciprocating Compressors</td>
<td>143,000</td>
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<tr>
<td>Centrifugal Compressors</td>
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<tr>
<td>Pneumatic Devices and Pumps</td>
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<tr>
<td>Recirculation Tanks for Well Stimulation</td>
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<td>Liquids Unloading</td>
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<td>Components under New LDAR Program</td>
<td>1,200</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>556,000</strong></td>
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