

Oil & Natural Gas Production, Processing, and Storage

Public Workshop



**California Air Resources Board
Sacramento, California
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Outline

- Background
 - AB 32
 - Oil & Gas Measure
 - Oil & Gas Industry Survey
- Preliminary Survey Results
- Testing Programs
- Next Steps
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Assembly Bill 32 (AB 32)

- California Global Warming Solutions Act of 2006
- Enacted to monitor and regulate Greenhouse Gas (GHG) emissions:
 - From Oil & Gas operations, primarily CO₂ and CH₄
- Requires that 2020 GHG emissions be reduced to 1990 levels
- Requires ARB to develop a Scoping Plan

Oil & Gas Measure

- Included in the Scoping Plan
- Designed to reduce fugitive CH₄ emissions from production, processing, and storage
- Formed district and industry working groups
- Conducted survey to estimate baseline GHG emissions

Oil & Gas Industry Survey

- Needed to quantify types of equipment and components to estimate 2007 GHG emissions
- Districts typically do not inventory GHGs
- Survey refines emission inventory and identifies the state of technology

Oil & Gas Industry Survey

- Survey developed with industry input
- Mailed out February 19, 2009
- Initial due date of April 30, 2009 (still receiving surveys and data)
- Using industry recognized emission factors to estimate a baseline emission inventory
- Baseline inventory will be used to assess potential emission reductions

Oil & Gas Industry Survey

- Extraction, production, processing facilities
- Drilling and well workover operations
- Crude oil storage, pipelines, loading operations
- Underground natural gas storage

Preliminary Survey Results

Survey Statistics

- 1429 surveys mailed out
- 960 removals
- 385 surveys received
- 84 extension requests outstanding

Preliminary Survey Results

Company Breakdown

- 301 Companies
- 1430 Facilities
 - 542 Crude oil facilities
 - 568 Dry gas facilities
 - 14 Crude oil and dry gas facilities
 - 306 Other facilities (e.g. gas plants, crude oil pipelines, well servicing)

Preliminary Survey Results

Global Warming Potentials

	CO ₂	CH ₄	N ₂ O
Second Assessment Report (SAR)	1	21	310
Third Assessment Report (TAR)	1	23	296
Fourth Assessment Report (FAR)	1	25	298

Values are in SAR for all subsequent slides unless otherwise noted

Preliminary Survey Results

2007 Total Emissions (Metric Tons)

	CO ₂	CH ₄	N ₂ O	CO ₂ E (SAR)	CO ₂ E (FAR)	Percent of Total CO ₂ E
Combustion	15,845,855	8,132	314	16,113,887	16,142,651	82%
Vented	36,438	59,133	0	1,278,231	1,514,763	8%
Fugitive	169,515	70,367	0	1,647,228	1,928,690	10%
Totals:	16,051,808	137,632	314	19,039,346	19,586,104	

Preliminary Survey Results

Compared With ARB's 2006 GHG Inventory (Million Metric Tons CO₂E)

	2006 GHG Inventory	2007 Survey	
	SAR	SAR	FAR
Combustion	17.9	19.0	19.5
Vented/Fugitive	0.8	2.9	3.4

Preliminary Survey Results

- Combustion numbers compare favorably with mandatory reporting
 - Mandatory reporting: 15.0 MMT
 - 2007 preliminary survey: 15.3 MMT
- Vented and fugitive numbers are higher than GHG Inventory
 - GHG Inventory estimated fugitives from districts' criteria pollutant inventory
 - GHG Inventory excluded most venting

Preliminary Survey Results

2007 Total Emissions by Size

Range (MT CO ₂ E per Facility)	Number of Facilities	MT CO ₂ E	Percent of Total CO ₂ E
< 10,000	1,333	889,656	5%
> 10,000 to 25,000	26	423,781	2%
> 25,000 to 50,000	21	780,255	4%
> 50,000 to 100,000	11	788,469	4%
> 100,000 to 500,000	30	5,978,735	31%
> 500,000	9	10,178,449	53%
Totals:	1,430	19,039,346	

Preliminary Survey Results

2007 Production Totals

Type	Barrels Crude Oil Produced/ Transported (bbls)
Ultra-Heavy Oil (API <10)	131,293
Heavy Oil (API 10 - 20)	151,772,639
Light Oil (API 20 - 30)	60,868,669
Ultra-Light Oil (API >30)	14,854,174
Crude Oil Pipeline	852,164,003

Type	Natural Gas Produced/Stored (mcf)
Associated Gas	305,648,255
Produced Gas	87,301,157
Natural Gas Storage	210,804,167

Preliminary Survey Results

Average 2007 Emissions per Barrel Crude Oil Produced

Range (bbls produced per year)	Number of Facilities	Total Crude Oil Produced (bbls)	Total CO ₂ E (Metric Tons)	Average MT CO ₂ E per Barrel
< 1,000	79	38,786	4,478	0.20
> 1,000 to 10,000	213	882,214	132,911	0.12
> 10,000 to 25,000	72	1,100,463	42,034	0.04
> 25,000 to 50,000	54	2,002,118	83,809	0.04
> 50,000 to 75,000	20	1,279,211	516,246	0.38
> 75,000 to 100,000	11	899,096	72,460	0.08
> 100,000	96	221,424,887	10,771,873	0.05

Preliminary Survey Results

Average 2007 Emissions per MCF Natural Gas Produced/Stored¹

Range (mcf produced per year)	Number of Facilities	Total MCF Natural Gas Produced/Stored	Total CO ₂ E (Metric Tons)	Average MT CO ₂ E per MCF
< 1,000	65	6,246	14,195	24.72
> 1,000 to 50,000	214	4,641,618	187,256	0.079
> 50,000 to 100,000	74	5,434,653	47,477	0.009
> 100,000 to 200,000	106	17,057,010	126,159	0.007
> 200,000 to 300,000	67	15,374,857	87,019	0.006
> 300,000 to 400,000	8	2,820,646	4,668	0.002
> 400,000 to 500,000	3	1,369,829	2,425	0.002
> 500,000	29	251,400,466	1,569,231	0.005

1. Excludes Associated Gas

Preliminary Survey Results

2007 Natural Gas Combustion Volumes

Type	Volume Produced (mcf)	Volume Combusted (mcf)	Percent Combusted
Produced Gas	87,301,157	4,585,522	5%
Associated Gas	305,648,255	54,819,498	18%
Waste Gas	16,957,167	16,957,167	100%

Preliminary Survey Results

2007 Combustion Emissions by Equipment Type (Metric Tons)

Type	CO ₂	CH ₄	N ₂ O	CO ₂ E	Percent of Total CO ₂ E
Steam Generator	6,658,573	120	115	6,696,706	42%
Combined Heat and Power	3,567,918	62	7	3,571,372	22%
Turbine	2,729,710	168	153	2,780,708	17%
Internal Combustion Engine	1,030,757	5,079	16	1,142,234	7%
Other	928,520	2,688	22	991,681	6%
Cogeneration	930,377	15	2	931,185	6%
Totals:	15,845,855	8,132	314	16,113,887	

Preliminary Survey Results

2007 Vented Emissions by Equipment Type (Metric Tons)

Type	CO ₂	CH ₄	CO ₂ E	Percent of Total CO ₂ E
Dehydrators	143	21,311	447,681	35%
Compressor Blowdowns	1,176	19,071	401,670	31%
Natural Gas Gathering Pipelines	2,888	10,473	222,829	17%
Other	32,232	8,277	206,051	16%
Totals:	36,438	59,133	1,278,231	

Preliminary Survey Results

2007 Fugitive Emissions by Equipment Type (Metric Tons)

Type	CO ₂	CH ₄	CO ₂ E	Percent of Total CO ₂ E
Sweetening	145,414	14,640	452,847	27%
Compressor Seals	1,848	15,987	337,566	20%
Dehydrators	11,910	11,299	249,196	15%
Other Natural Gas Processing	8,165	11,264	244,716	15%
Storage Tanks	1,083	11,495	242,472	15%
Other	1,096	5,683	120,430	7%
	169,515	70,367	1,647,228	

Preliminary Survey Results

Future Activities

- Upload remaining surveys
- Evaluate outlying data
- Explore developing new emission factors
 - Storage tanks
 - Separators
 - Well completions
 - Newly drilled wells
 - Components
 - Automated control devices
 - Flares

Testing Programs

- California Energy Commission contract to develop new natural gas system emission factors
 - August 2009 through summer 2010
 - Technical Advisory Committee
- Air Resources Board contract to develop new emission factors for oil fields
 - October 2009 through summer 2010
 - Extensive industry input

Next Steps

- Continue working on survey results
- Welcome comments on preliminary data
- Testing programs proceeding
- Future workshops on control concepts and regulatory language

ARB Oil & Gas Contacts

Web Page:

<http://www.arb.ca.gov/oil-gas/oil-gas.htm>

List Serve:

http://www.arb.ca.gov/listserv/listserv_ind.php?listname=oil-gas

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