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# California Methane Inventory

## Inventory Development and Opportunities for Refinement

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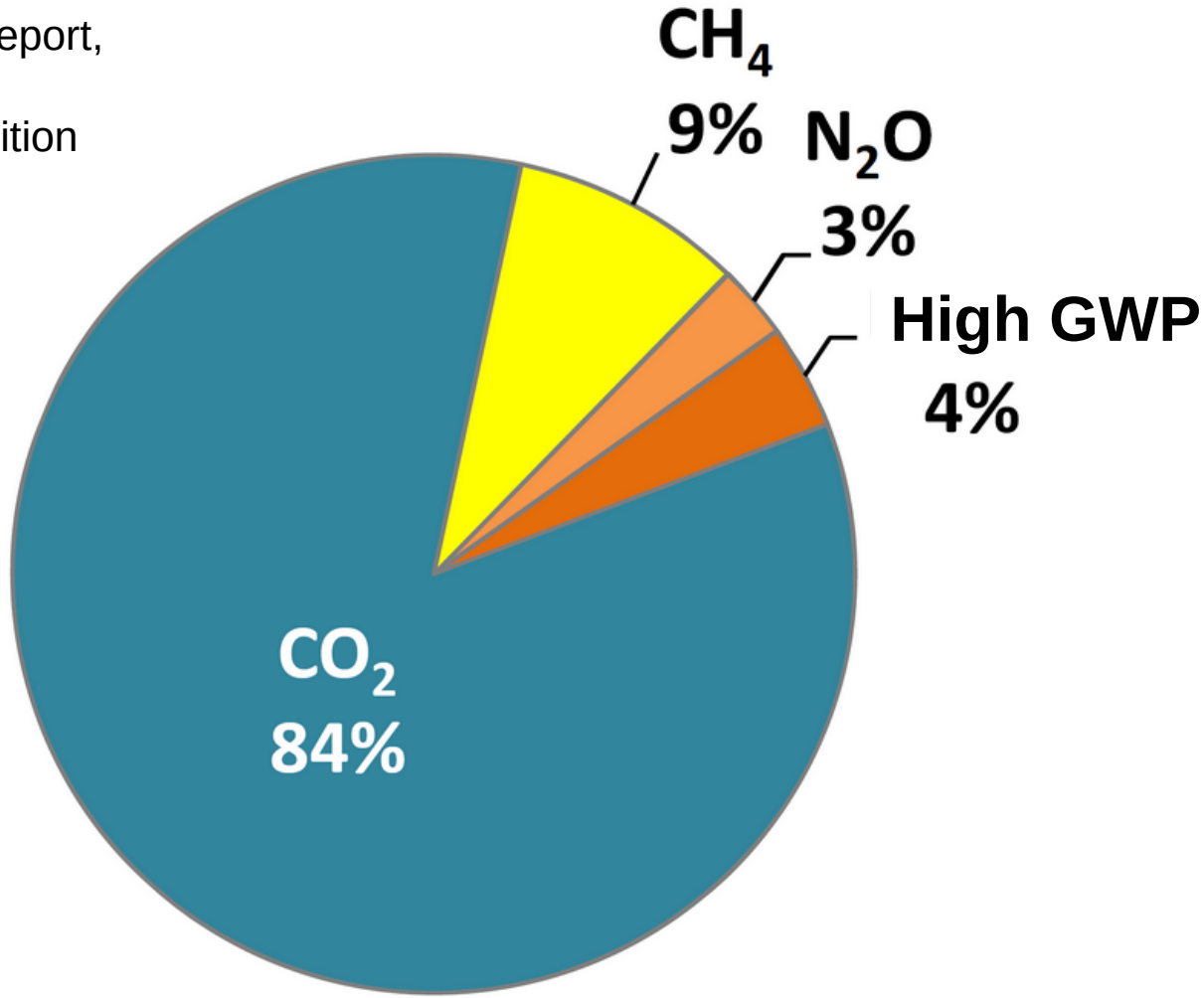
Methane Symposium

# GHG Inventory- Background

- In 2006, AB 1803 (H&SC §39607.4) gave ARB the responsibility to develop and maintain a state-wide greenhouse gas (GHG) emission inventory.
- The inventory follows Intergovernmental Panel on Climate Change (IPCC) Guidelines to ensure consistency and comparability with other national inventories.
  - Provides estimates of the amount of GHGs emitted to the atmosphere by human activities within California.
- AB 32 provided additional instruction to inventory compilation:
  - Explicitly name 7 GHGs: $CO_2$, $CH_4$, $N_2O$, HFCs, PFCs, $SF_6$, $NF_3$
  - Also include emissions from generation of imported electricity
  - Establishment of 1990 emission level and 2020 emission limit

# California GHG Inventory by Pollutant

IPCC 4th Assessment Report,
100-Year GWP
GHG Inventory 2015 edition




**2013 Total CA Emissions: 459.3 MMTCO2e**

# GHG Quantification Method

*Over 80% of the emissions in the GHG inventory are quantified using the methods below and subject to 5% accuracy standard:*

- **Direct Emissions Measurement:**
  - CO2 Continuous Emission Monitoring Systems (CEMS) at some high-emitting facilities
- **Direct Fuel Measurement:**
  - Fuel use is tracked and reported through Mandatory GHG Reporting Regulation (MRR) and other state and federal agencies (e.g. BOE, EIA, CEC)
  - Emission factors, heat content, carbon content: may be either default factors or source-specific factors measured by periodic sampling

# California Methane Inventory

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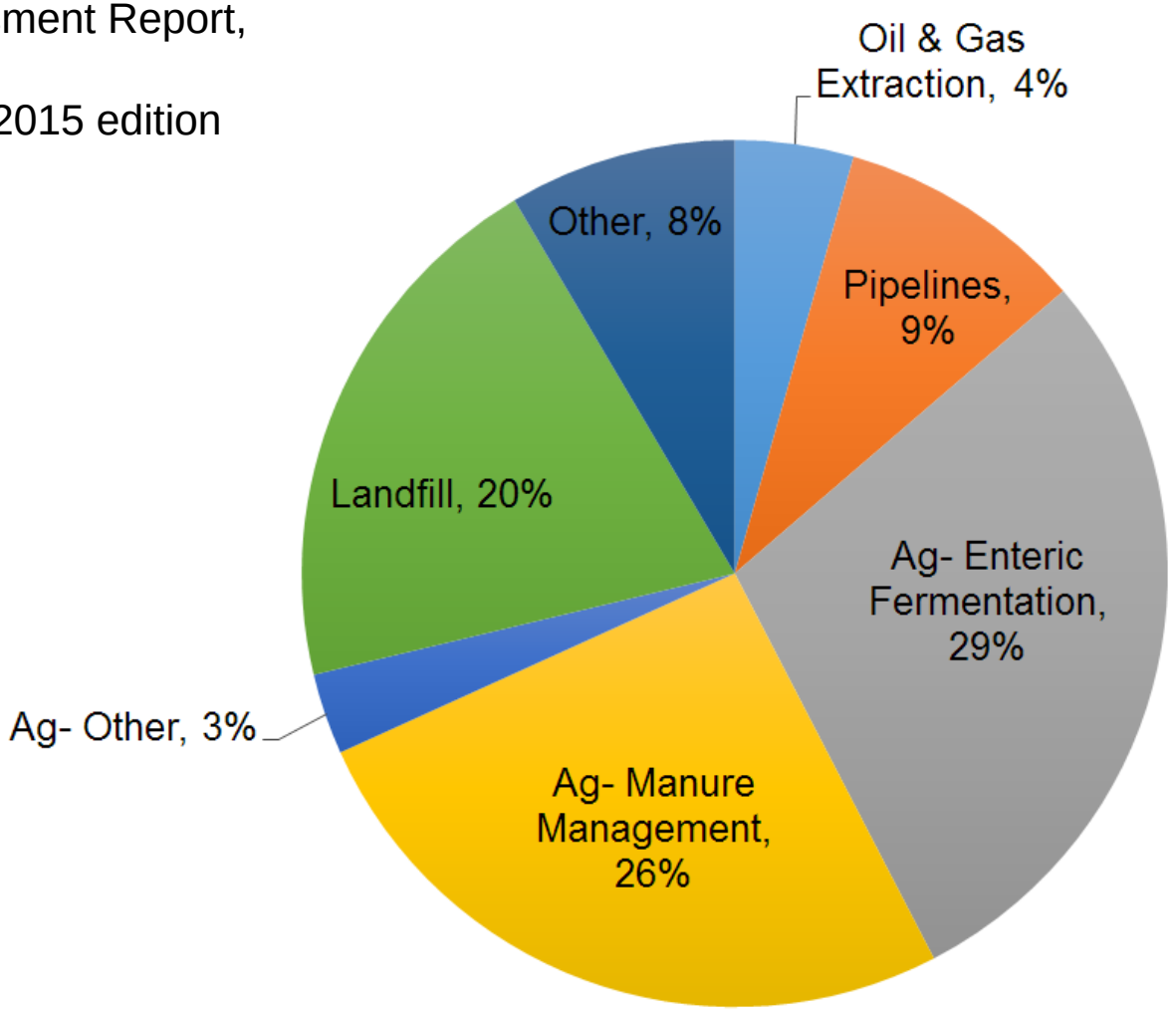


**2013 Total CH4 Emissions: 41.1 MMTCO$_2$e**

# Methane Emissions Quantification

- Most of the $CH_4$ emissions come from non-combustion sources and are not directly measured
- Estimated based on a combination of modeled or default emission factors, estimates of activity data, and modeled emissions
- Modeling based on indirect factors, such as nutrient contents of livestock feed and the amount and types of waste in landfills
- Sometimes source tests may be used for determining emission factors to represent the source type
- There is higher uncertainly associated with these estimates

# Current Inventory Methods for Methane Sources

- **Oil & Gas Production, Transmission and Distribution**
  - Based on two comprehensive ARB surveys (2007 data)
  - Time series of emissions estimated by mapping trends in surrogate data to emissions derived from ARB surveys
    - Production: USEPA national inventory data
    - Transmission: PHMSA data
    - Distribution: residential housing unit data
- **Landfills**
  - First-Order Decay Model (IPCC Methodology)
  - CalRecycle waste deposition and characterization
  - Carbon content and degradation factors from EPA, CEC, and IPCC

# Current Inventory Methods for Methane Sources

- **Wastewater Treatment**
  - Domestic wastewater treatment based on USEPA's estimation of parameters and emission factors
  - Industrial wastewater emissions:
    - Petroleum refining wastewater: CEC production data
    - Agricultural processing wastewater: CDFA & USDA data
    - Other industrial sources: ARB criteria TOG data speciated for $CH_4$
- **Dairy Livestock**
  - Based on USEPA model of enteric fermentation & manure management
  - Parameters: animal type, age, size, feed, waste type & management

# GHG Inventory Improvements

- Routine method & data updates:
  - Use improved emissions estimation methodology
  - Update activity data and emission factors
  - Incorporate latest knowledge about emission sources
  - Modify inventory categorization in response to program needs
- In accordance to IPCC Guidelines, update the entire time series from 2000 to current year with the latest methods, science, and data sources each year.
  - Emissions estimates from older years may be revised if data source agencies revise the data series or if methods are updated

# Upcoming Oil & Gas Inventory Improvements

- Recent Oil & Gas Methane Regulation development can lead to several inventory improvements:
  - Fugitive emission estimates account for high-emitter components
  - Large reciprocating and centrifugal compressor seal emission estimates based on operator's emissions data
  - More comprehensive methodology developed for the regulation is used for separator and tank emission estimates
- Anticipated timeframe:
  - Oil & Gas Methane Regulation process completed by mid-2017
  - 2018 edition of the GHG inventory

# Upcoming Oil & Gas Inventory Improvements

- *SB 1371 – Natural Gas Leakage Abatement:* reduce methane from the transmission & distribution sector
  - Utilities file annual reports on emissions and leak management practices
  - Estimate emissions based on the number of leaks instead of length of pipelines and USEPA default emission factors
  - Track number of open leaks
- ARB-funded studies in the works:
  - California-specific emission factors for distribution pipelines (recently completed; results are under review)
  - Customer meters study (proposed)

# Methane Emission Sources That Still Need Further Data or Method Development

- Leaks from Residential Appliances: preliminary results from CEC-funded study conducted by Lawrence Berkeley National Lab suggest these may be substantial
- Abandoned Oil & Gas Wells: may be significant but little data are available at this time
- Petroleum Seeps (a natural source): existing estimate is based on local air district information that is not comprehensive and may be outdated

# Methane Emission Sources That Still Need Further Data or Method Development

- Wetland Methane: international dialogue on quantification method
- Methane from Water Bodies: little or no data available but potential sources may include:
  - *Hydropower water discharge*
  - *Reservoir water releases*
  - *Water bodies (lakes and ponds)*
  - *Near shore ocean upwelling*

# Future Work

- For sources already in the inventory, continue to:
  - update the data used in emission calculations based on latest available information
  - refine emission estimation methods based on new research and studies
  - refine accounting of impacts of emission reduction measures
- For sources not already in the inventory:
  - identify potential data sources and develop methods for emission quantification
  - continue dialogues among stakeholders and research community
- Many interesting research and studies by academics, non-profit organizations, and industry

# Q & A

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