Oil and Gas Emission Inventories and Applications for Estimating Impacts to Health and Welfare

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Outline

- O&G regulatory air emission inventories
  - Regulatory drivers and structure
  - Scope and methods
  - Strengths and limitations
- Health and welfare analysis applications
  - Basis for estimating exposure
  - Sample applications
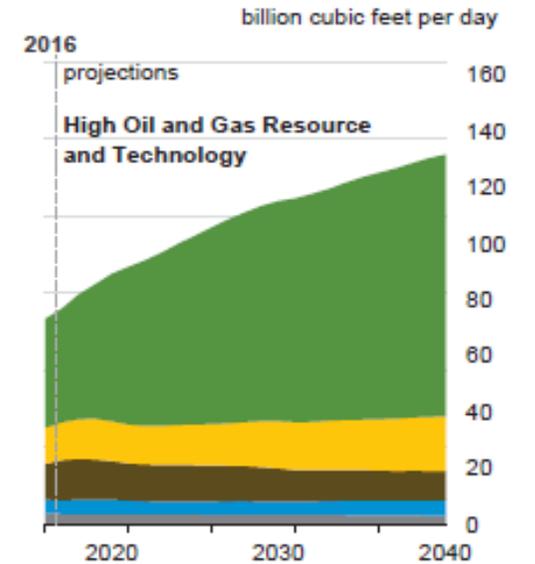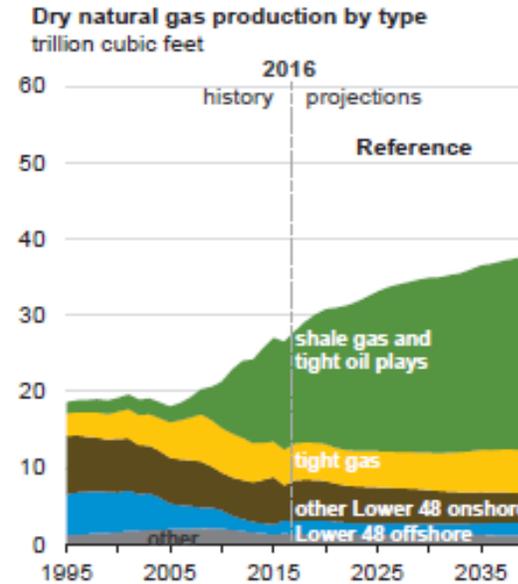
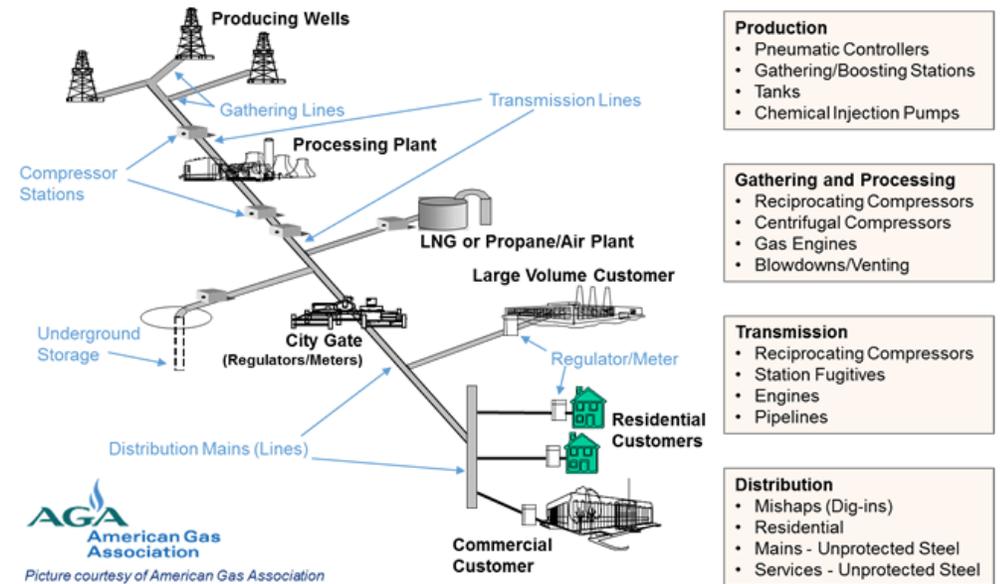# Clean Air Act - Emissions Management Structure

- Cumulative environmental burden - NAAQS, Regional Haze, PSD increment
  - Pollution allowed – track emissions rates and change over time
  - CAA cooperative federalism - focus on emissions mgmt. structures in state programs
    - Solutions at appropriate geographic scale reduce air quality impact and environmental exposure

- Challenges for consistent-accurate-precise O&G emission inventories
  - Rapid / continuing change in production types, practices, technologies, commodity price swings, end-user demand, geographic variation, processing and transportation, et cetera
  - Need for projected future emissions incorporating growth / control
    - Future emissions are to be based on changes from a well-characterized historic base year, to assess air quality response

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Regulations

- State permitting, registration, and/or reporting (tracking) via rules and emissions control strategies in "implementation plans"
  - At source / process level – compiled in national databases and basin studies
  - Allows integrated GHG, health (criteria), and air toxics pollutant strategies
  - Ancillary benefit - less waste of O&G commodity products

- Federal technology-based control rules / national GHG emissions reporting

- Federal mineral leasing process - NEPA analysis

Scope

- Sources: wells → gathering/processing → transmission/distribution → end user (domestic)
  - Source category classification (SCC): process specific
    - E.g., tank flashing, pneumatic controllers, drill rig diesel engine, 4-stroke natural gas engines)
- Pollutants: Criteria pollutants / air toxics / GHGs
- Spatial: US-wide
  - Point: Source location (lat/lon)
  - Nonpoint: County-level
- Temporal: Annual
  - US-wide: triennial (historical), several future years
  - Project/NEPA: project dependent

Picture courtesy of American Gas Association

Production
- Pneumatic Controllers
- Gathering/Boosting Stations
- Tanks
- Chemical Injection Pumps

Gathering and Processing
- Reciprocating Compressors
- Centrifugal Compressors
- Gas Engines
- Blowdowns/Venting

Transmission
- Reciprocating Compressors
- Station Fugitives
- Engines
- Pipelines

Distribution
- Mishaps (Dig-ins)
- Residential
- Mains - Unprotected Steel
- Services - Unprotected Steel

Methods

- Point sources: Direct reporting to State/Local/Tribal Agencies

- Nonpoint sources: Emissions = Activity × Emission factors

- Emission factors

  - Reference compilations/models (e.g., AP-42, MOVES)

  - Manufacturer Specifications

  - Industry models (e.g., E&P Tank, ProMax)

  - Based on evolving equipment and control configurations

    - Timely update is critical

Regulatory Inventory	**Facility / Top-down Studies**
source category	facility/area-wide
emission factors	direct measurements

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Strengths, Limitations

- Strengths
  - Existing requirements to develop emission inventories (e.g., US-wide triennial updates, NEPA)
  - Consistency in organizational structure
  - Comprehensive: wells → end user
  - Designed to be used within CAA and NEPA regulatory framework
    - Controls strategy analysis, air quality impacts analysis
- Limitations and Future Improvements
  - Analysis required to develop health and welfare analyses
  - Inconsistent data collection and/or methods can lead to regional differences
  - Emission factor updates typically lag research

Inventories – Fundamental Input for Estimating Exposure

- Emissions control technology and strategy rules lead to lower emissions rates in the future

  - Per capita, unit-level, process activity emissions rates are all lower for new equipment and operational practices – competition and regulation interact

  - Equipment turnover and best practices implementation are both fundamental regulatory assumptions

- Future air quality impacts and exposure estimates are from projections of individual emissions sectors like O&G exploration and production

  - Emissions standards and operating costs for all other sectors are interlinked with O&G E&P – electricity production, mobile engine fuel consumption, et cetera

  - Assessed in cumulative impact modelling that include O&G with other source sectors

  - Rural vs. Urban

  - Production estimates from economic forecasts provide one means to assess future emissions

  - Basins are geographic areas with infrastructure investments and cultural / economic knowledge of O&G E&P, so historic trends also affect future emissions estimates

Application Examples for Regulatory Inventories

- Analyses of criteria pollutant and air toxics monitoring data

- Nonattainment planning to achieve NAAQS

- Regional haze planning for progress in reducing anthropogenic emissions

- NEPA project and resource mgmt. planning

- Tracking of national / state criteria pollutant trends / GHG emissions goals

- Regional modelling of background / transported ozone, PM, regional haze

- Chronic exposure studies – linkages to emissions regulation strategies

Modeling Applications

Local (AERMOD, CalPuff)

- Local applications to estimate exposure at nearby receptors

- Modeled exposures typically compared to reference exposure limits (RELs)

- Example map, well drilling concentration gradients:
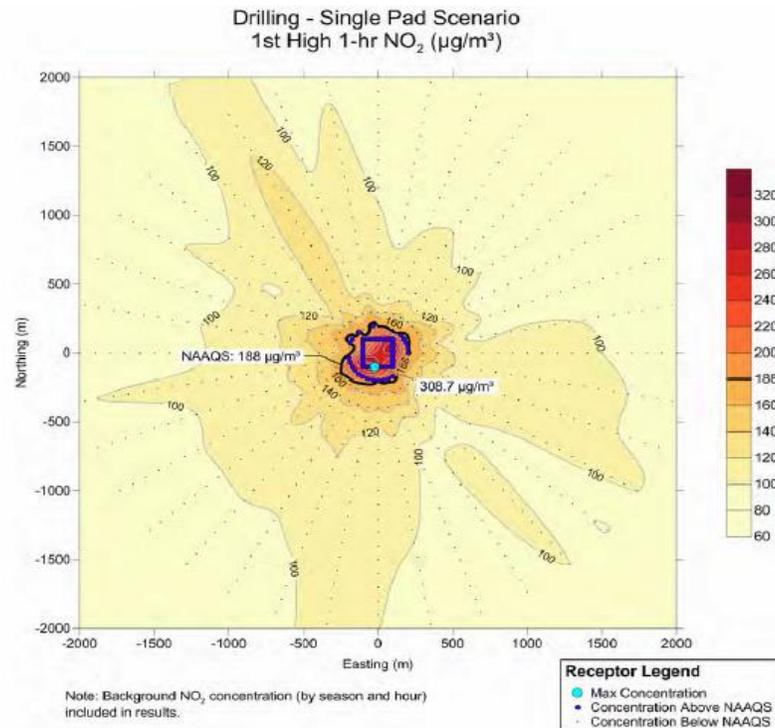
Regional (CAMx, CMAQ)

- Regional, multi-source applications to estimate by sector/cumulative impacts

- Model chemistry allows for modeling of more pollutants than can be measured

- Example map, O&G development contributions to ozone in Colorado:
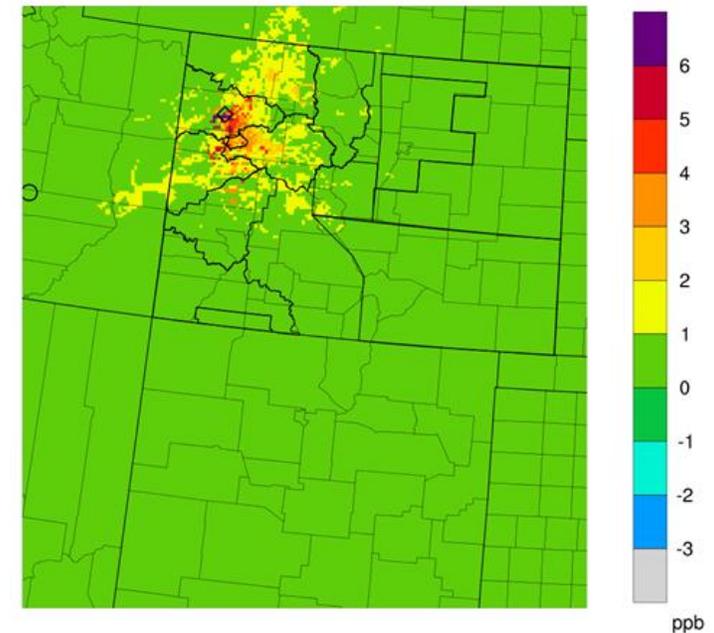
Acknowledgements & Sample Resources

- EPA
  - [EPA Triennial National Emission Inventory](#) (compiled from state inputs)
  - [EPA Modeling Platforms](#)
  - [Inventory of U.S. Greenhouse Gas Emissions and Sinks](#)
  - [Greenhouse Gas Reporting Program](#)
- BLM
  - [NEPA Project and Planning](#)
  - [Colorado Air Resources Management Modeling Study](#)

- WESTAR-WRAP
  - [O&G Emissions Inventory Project: Greater San Juan and Permian Basin](#)
  - [O&G Emissions Inventory Project: ND-SD-MT Williston and MT North Central (Great Plains) Basins](#)
- Regional Planning Organizations (WESTAR-WRAP, MARAMA, CenSARA, LADCO, SESARM)
  - [National Oil and Gas Emissions Analysis project](#)
  - [National Oil & Gas Emissions Committee Information Repository](#)
  - [Regional modeling studies for air quality planning](#)
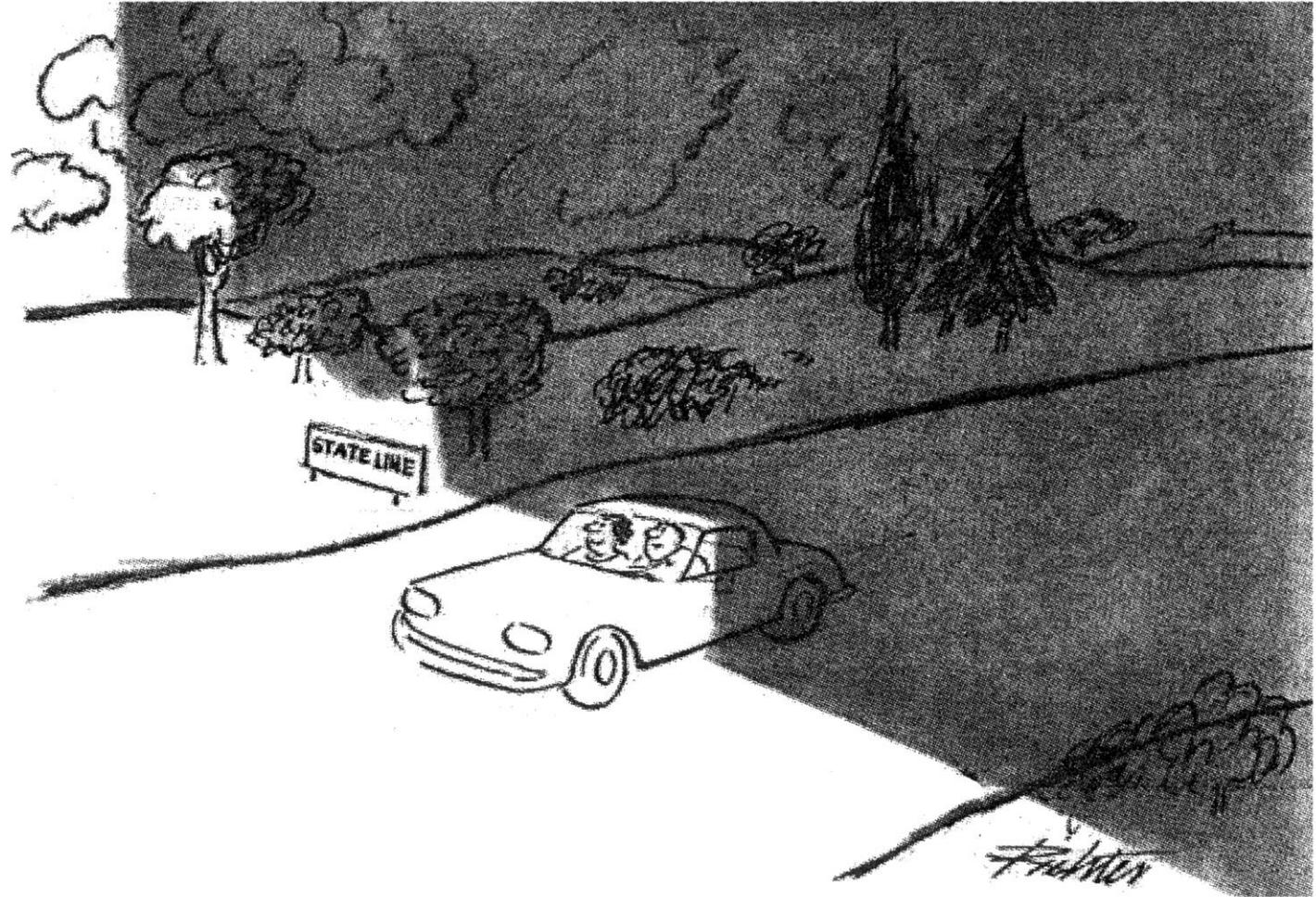- State and Tribal Inventory Studies

Thank you.

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"They have very strict anti-pollution laws in this state."