

Western States Air Quality Study



Intermountain West Data Warehouse

Western States Air Quality Study Modeling and Analysis of Oil & Gas Emissions Data

University of North Carolina (UNC-IE)

ENVIRON International Corporation (ENVIRON)

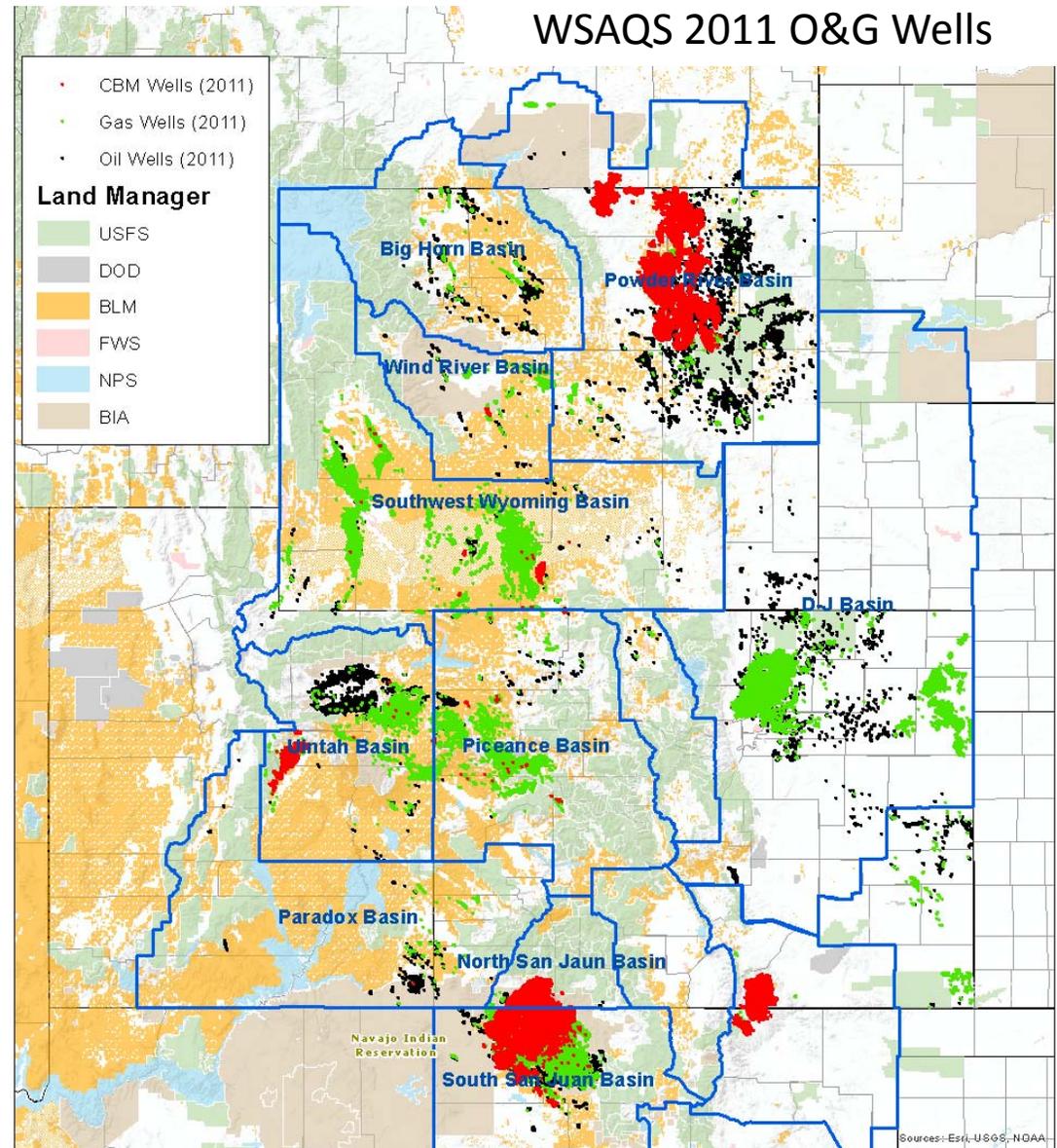
Presented at the Western Air Quality Modeling Workshop

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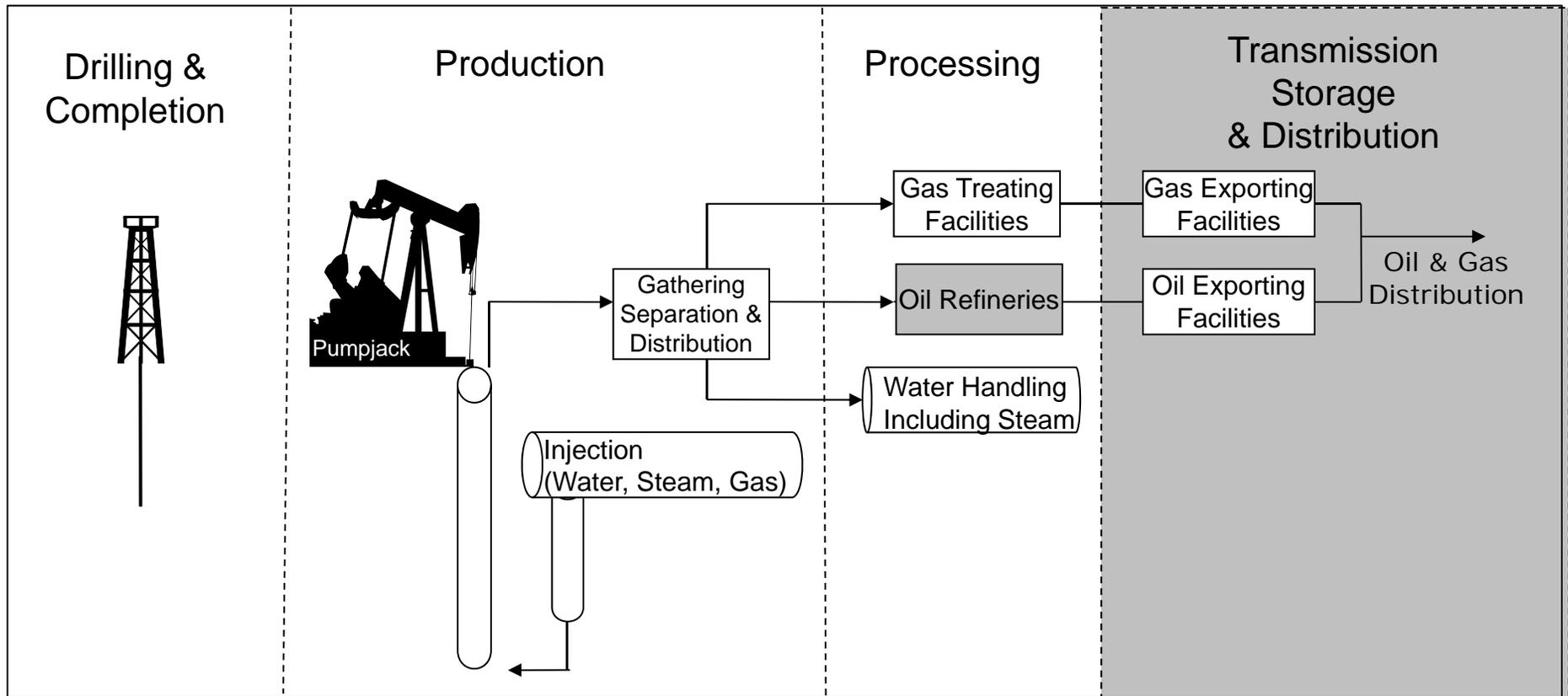


Summary

- WSAQS O&G Emissions Inventory and Data
- O&G Emissions Modeling and Evaluation

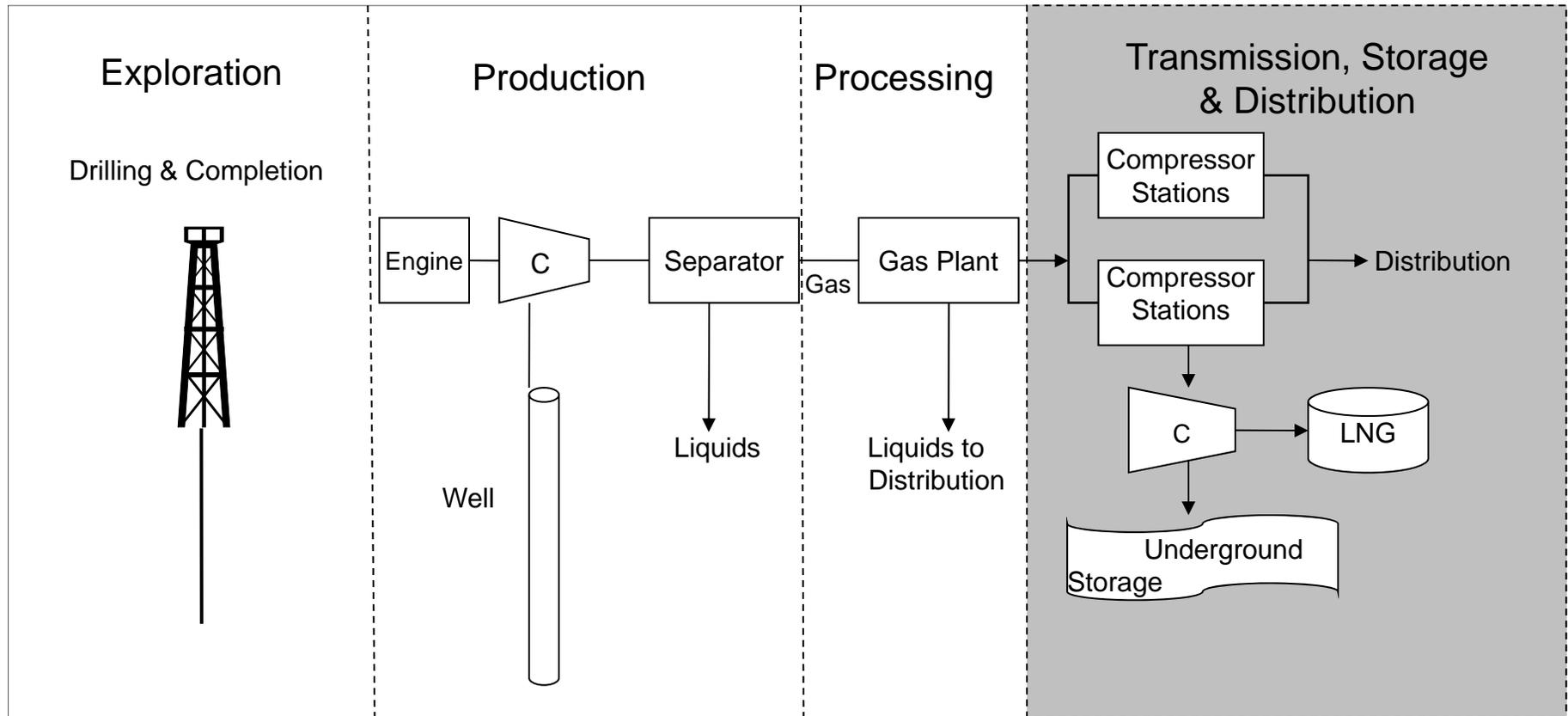


EXAMPLE OF UPSTREAM SECTOR WHERE THE WELLS ARE PRIMARILY INTENDED TO PRODUCE OIL (LIQUID HYDROCARBONS)



WRAP inventories cover upstream and midstream – from well to inlet of a refinery

EXAMPLE OF UPSTREAM SECTOR WHERE THE WELLS ARE PRIMARILY INTENDED TO PRODUCE NATURAL GAS



WRAP inventories cover upstream and midstream – from well to outlet of a gas plant

WSAQs O&G Inventories

First phase: 2011 emissions estimates

- Include well-site through midstream sources
- Require both survey data and point source data from state permit
 - Varies by state
 - Colorado and Wyoming provide detailed databases for most emission sources
 - For Utah and New Mexico most sources estimated from surveys
- Based on projections of 2006 survey data
 - 2006 → 2008 → 2011
- Depending on the state, midstream sources often not adequately covered (if based on surveys)
- **Best-understood emissions are from permitted sources**



WSAQS O&G Inventories

Second phase: Assemble inputs for 2014 emissions

- Increase coverage of source categories
 - Include tribal minor source data for midstream sources and some well-site sources
 - More information on episodic events (liquids unloading, upsets, blowdowns)
- In Utah, New Mexico and Colorado conduct new well-site surveys
 - Previous surveys are out of date – over 8 years old
- Improve geographic resolution
 - Break basins into various sub-basin regions by formation or field
 - More resolution on activities and source types by formation/field
 - More resolution on gas compositions by formation/field



WSAQs O&G Inventories

Basins in First Phase – 2011 emissions

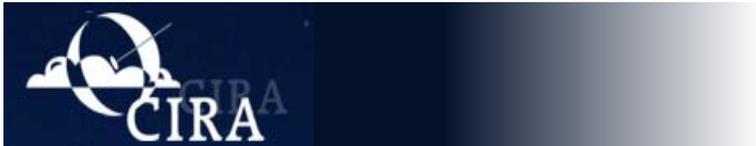
- Linear growth and controls since 2006 base year with full survey, permit, and production analysis, including intermediate 2008 data
- Big Horn (WY, MT) – Oil and gas
- Denver-Julesberg (CO) – Oil and gas
- North San Juan (CO) – Oil, gas, and CBM
- Paradox (CO, UT) – Mostly oil
- Piceance (CO) – Oil, gas, and CBM
- Powder River (WY, MT) – Oil, gas, and CBM
- Raton (CO, NM) – Gas and CBM
- Southwest Wyoming (WY) – Oil, gas, and CBM
- South San Juan (CO, NM) – Oil, gas, and CBM
- Uintah (UT) – Oil, gas and CBM
- Wind River (WY) – Oil, gas, and CBM



WSAQs O&G Inventories

Basins in Second Phase – 2011 and 2014 emissions

- Largest of first phase basins in each state
 - Full survey, permit, and production analysis
- Great Plains (MT) – Oil and gas
- Williston (MT, ND, SD) – Oil and gas
 - Full survey, permit and production analysis
- Permian (NM, TX) - Oil and gas
 - Growth and control since 2008 base year



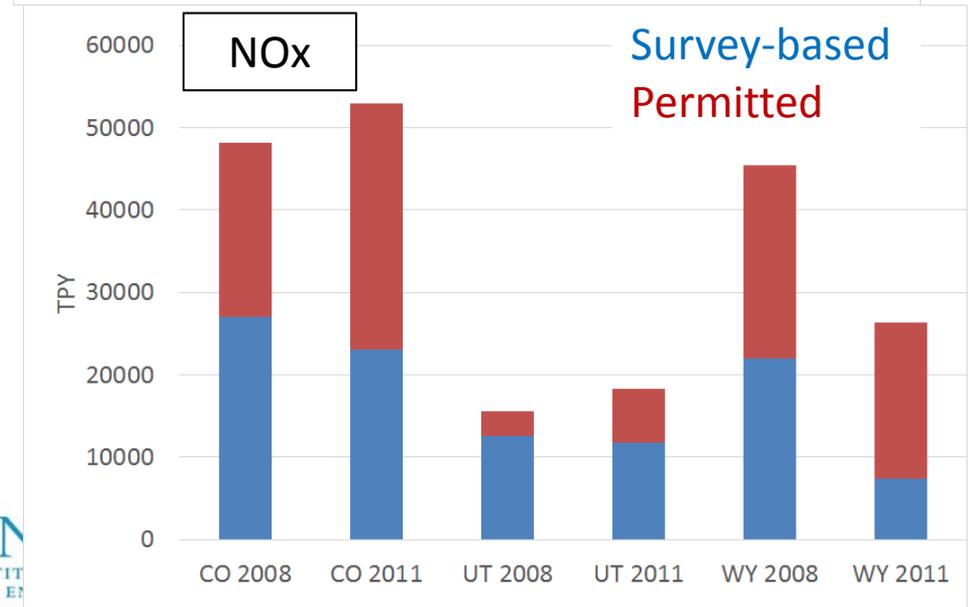
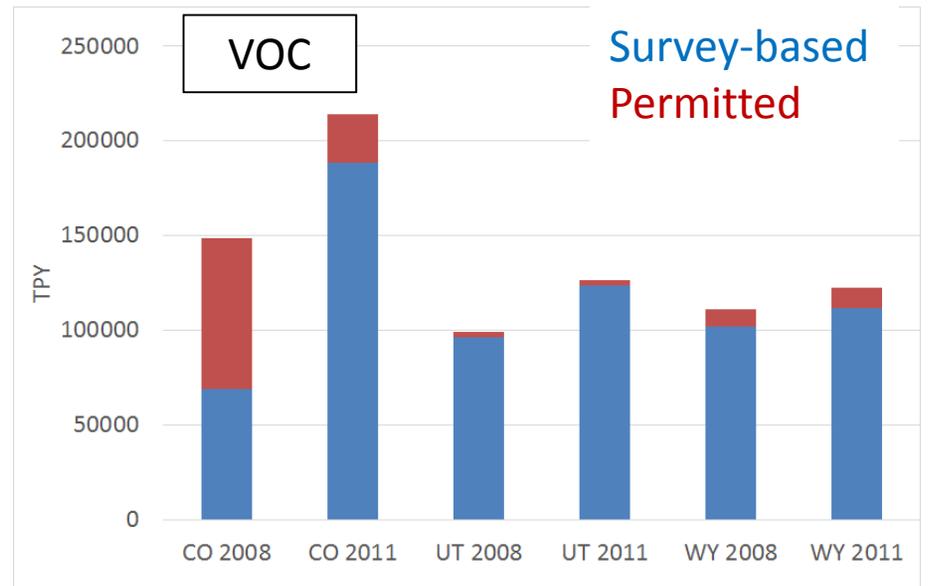
WSAQS O&G Inventories

- NEI2011v1 and v2 are used for the production emissions outside of the project inventories
- Reconciliation between the NEI and project inventories is not easy
 - O&G sources are included in the NEI non-O&G inventory sectors
 - Non-O&G sources are included in the NEI O&G inventory sectors
 - Engines are not coded to be specific to O&G production
 - Ambiguity in the midstream sources



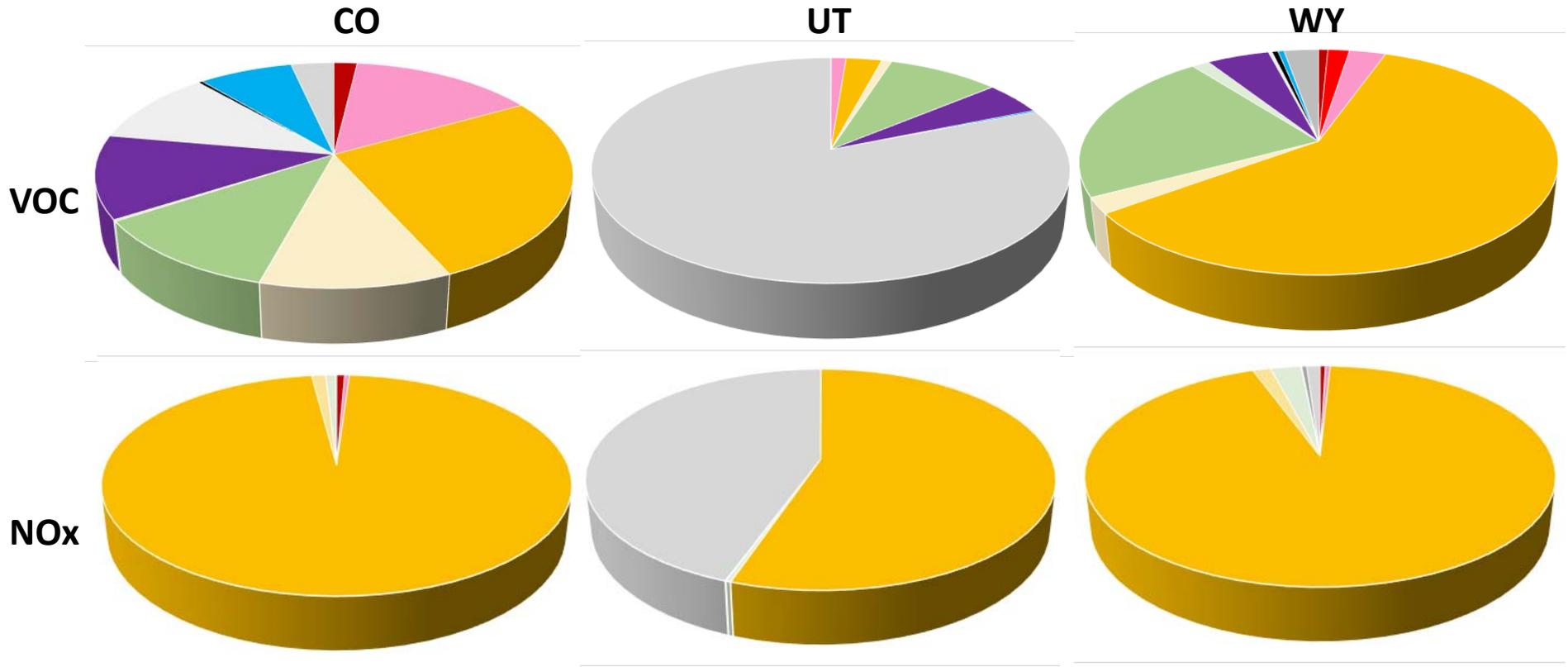
WSAQs O&G Inventories

- 2011 First Phase Inventory
- Permitted sources
 - Generally point source inventories with coordinates and stack information
 - Smaller sources are carried as area sources
- Survey-based sources
 - Non-point/area sources (county totals)



WSAQS O&G Inventories

Permitted Sources in 2011 First Phase



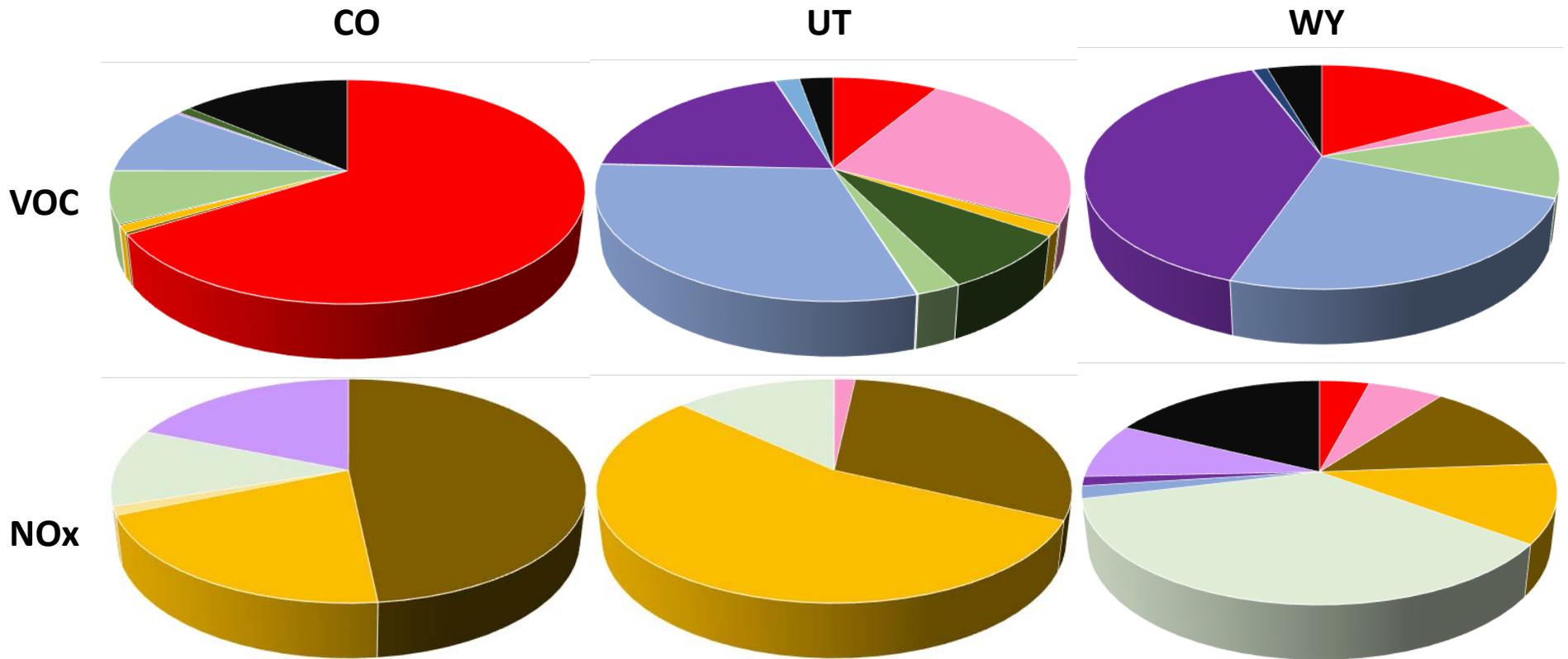
- | | | |
|-----------------|--------------|-------------------|
| ■ Amine Unit | ■ Condensate | ■ Dehydrators |
| ■ Engines | ■ Flares | ■ Flashing |
| ■ Fugitives | ■ Heaters | ■ Tanks |
| ■ Truck Loading | ■ Venting | ■ Waste Treatment |
| ■ Other | | |



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WSAQS O&G Inventories

Survey-Based Sources in 2011 First Phase



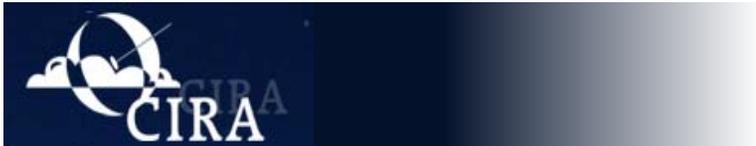
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|-----------------|---------------------|------------------|
| ■ Amine Unit | ■ Condensate | ■ Dehydrators |
| ■ Drill Rigs | ■ Engines | ■ Flares |
| ■ Flashing | ■ Fugitives | ■ Heaters |
| ■ Mud Degassing | ■ Pneumatic Devices | ■ Produced Water |
| ■ Tanks | ■ Truck Loading | ■ Venting |



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WSAQS O&G Emissions Modeling

- Spatial Surrogates
 - Developed from well locations and production-level data within each basin
- Temporal Profiles
 - Generally flat (365/24/7)
- VOC Chemical Speciation
 - Basin specific profiles for produced gas
 - Combustion source profiles (e.g. engines and flares) from SPECIATE4; need review!



Conclusions

Technical methods to estimate O&G emissions for intermountain West Basins are well-documented and robust

- Key inputs:
 - Production data are high quality and complete
 - Permit and registration data, and reporting information from states and EPA are increasingly detailed and complete – need analysis and assimilation
 - Activity data for O&G resources – both existing and currently being developed - production, practices, equipment, control programs all changing separately and together
 - Assumptions about holding constant and applying historic configurations of equipment and practices to represent point and area sources into the future are not valid

Conclusions

Technical methods to estimate O&G emissions for intermountain West Basins are well-documented and robust

- **Challenges:**

- Spatial distribution of survey-based area source estimates
- Chemical speciation of VOCs from combustion sources
- Timing and locations for large emissions events (i.e. recompletions and blowdowns)
- Evaluation of O&G emissions in air quality models is needed to improve the inventories – leading to improved model performance
 - For same reasons associated with activity mentioned previously