BOEM Arctic Air Quality Modeling Study

Presented to

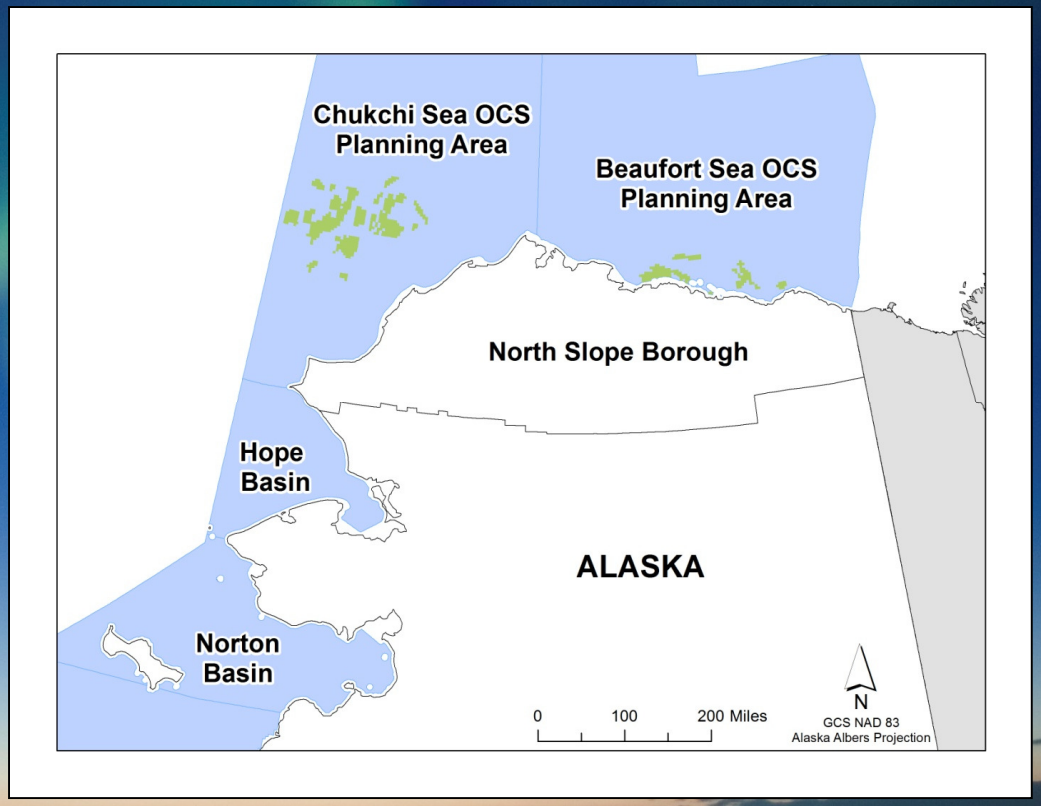
United States and Canada Northern Oil and Gas Research Forum

Presented by

Paula Fields Simms

Eastern Research Group

October 12, 2017



BOEM Bureau of Ocean Energy Management

ERG

RAMBOLL ENVIRON

Technical Team

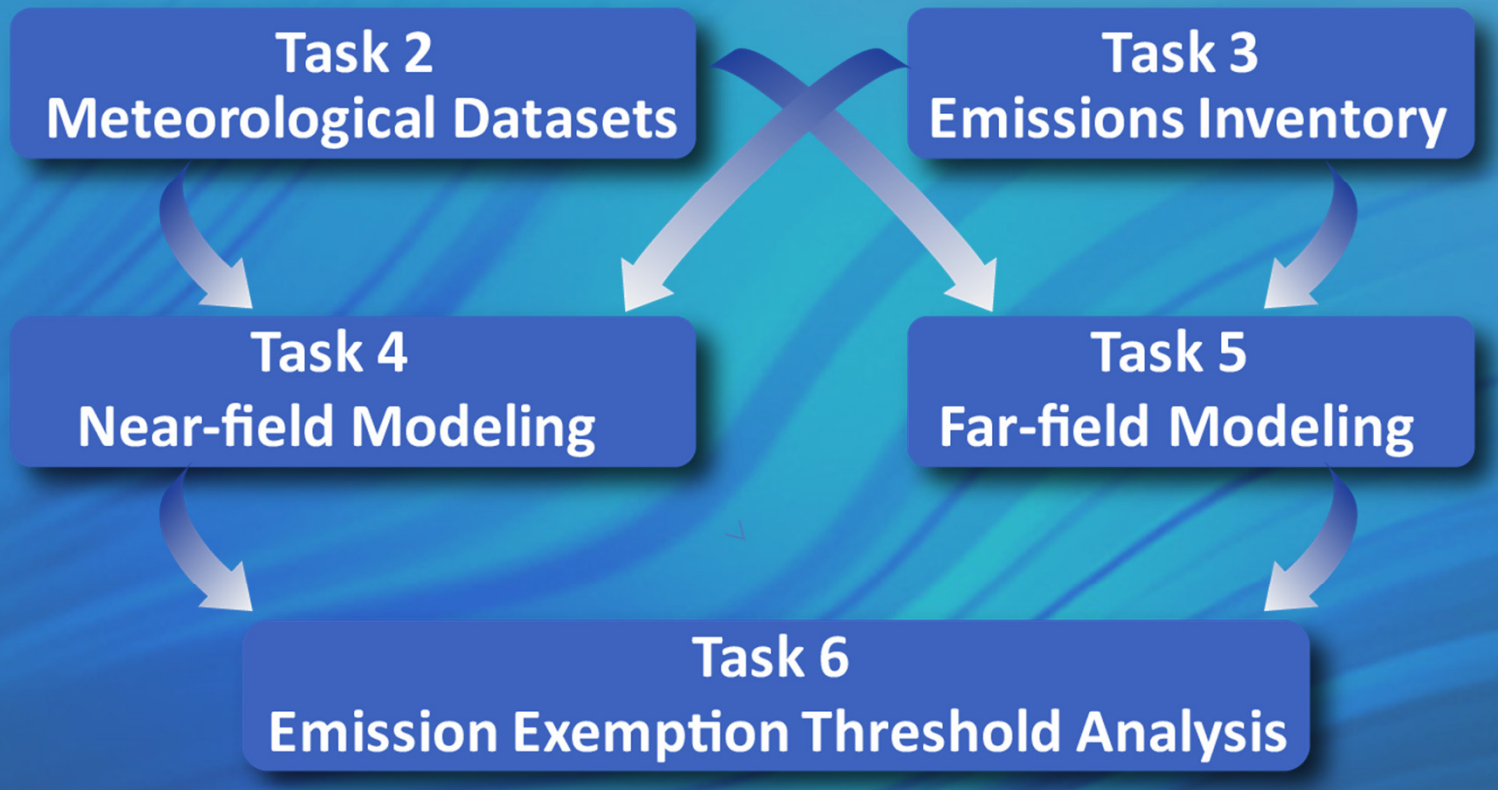
- Bureau of Ocean Energy Management, AKOCSR
  - Dr. Heather Crowley
  - V.J. Maisonet-Montanez
- ERG Technical Leads
  - Bebhinn Do
  - Richard Billings
  - Regi Oommen
  - Marty Wolf
- Ramboll Environ Technical Leads
  - Ralph Morris
  - Till Stoeckenius
  - Dr. Bart Brashers
- Science Review Group
  - Dr. David Allen, UT
  - Dr. Brian Lamb, WSU
  - Tom Moore, WESTAR

BOEM Bureau of Ocean Energy Management

ERG

RAMBOLL ENVIRON

Arctic Air Quality Modeling Study



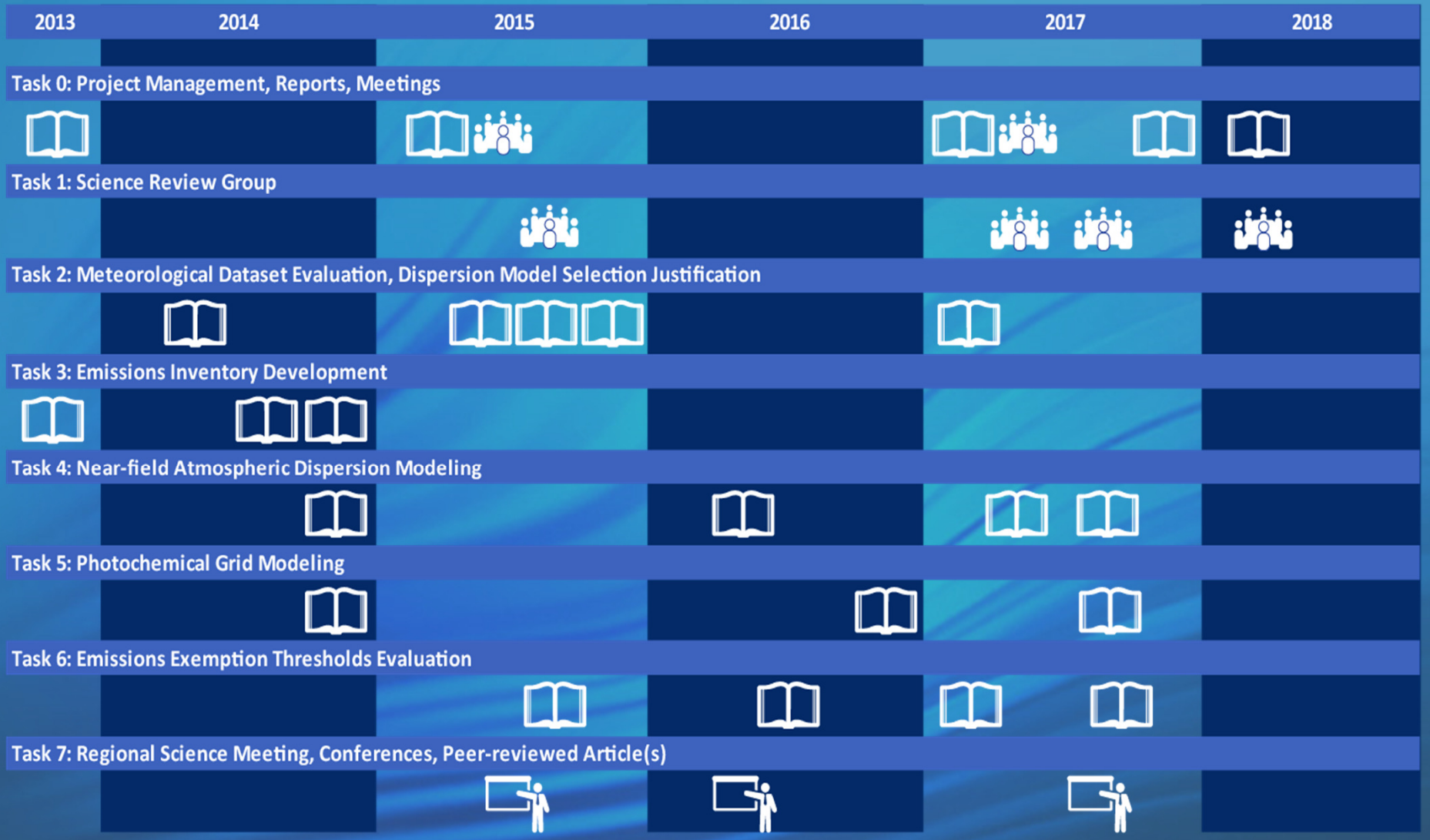
Overall Objective: Assess potential air quality effects from oil and gas exploration, development and production on the Alaska OCS and in near-shore state waters.

BOEM Bureau of Ocean Energy Management

ERG

RAMBOLL ENVIRON

Study Timeline and Status



Protocols, Draft & Final Reports, Final Datasets

Meetings

Conference Presentations

BOEM Bureau of Ocean Energy Management

ERG

RAMBOLL ENVIRON

Presentation Overview

- Task 3: Emissions Inventory
- Task 4: Near-field Atmospheric Dispersion Modeling
- Task 6: Emission Exemption Threshold Evaluation

Objectives
Methods
Results

Ralph Morris of Ramboll Environ will discuss the meteorological dataset evaluation (Task 2) and photochemical grid modeling (Task 5) in the next presentation.

BOEM Bureau of Ocean Energy Management ERG RAMBOLL ENVIRON

Emissions Inventory – Objectives & Scope

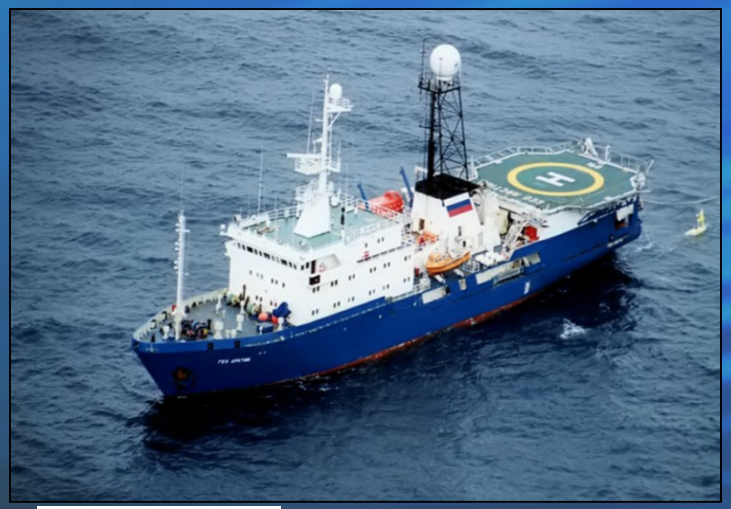
- Pollutants - CAPs, HAPs, GHGs, H_2S, NH_3
- Domain - North Slope Borough and BOEM Planning Areas
- Sources
  - Stationary and mobile including on- and off-shore O&G, communities, road dust, airports, TransAlaska Pipeline
- Annual Emissions
  - Baseline, generally 2011 or 2012
  - Projections, based on hypothetical "full build out" scenario
- Spatial and Temporal Resolution - Geographic coordinates or surrogates, temporal profiles

BOEM Bureau of Ocean Energy Management ERG RAMBOLL ENVIRON

Offshore Sources

Emission Sources

- Seismic survey operations
- Exploratory drilling
- Commercial marine and research vessels
- Aircraft



Methods & Data

- GHG, Regulated Emissions, and Energy use (GREET) model emission factors
- HAP speciation factors
- Derived vessel activity in kW-hrs from Internet sources, Marine Exchange of Alaska
- FAA's Emissions & Dispersion Modeling System (EDMS)

BOEM Bureau of Ocean Energy Management ERG RAMBOLL ENVIRON

Onshore Oil & Gas

Emission Sources

- Seismic surveys
- Exploratory drilling, well completions
- Prudhoe Bay, other North Slope fields

Methods & Data

- G & G permits
- Drilling rig permits
- 2011 NEI
- ADEC permit data
- GHGRP subparts W and C for Reporting Year 2012
- EPA's Nonpoint Oil and Gas Emissions Estimation Tool

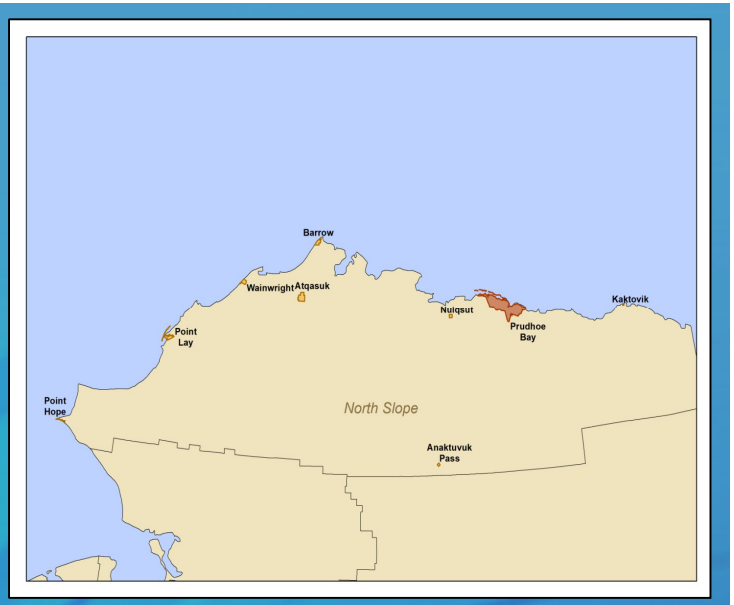
BOEM Bureau of Ocean Energy Management

ERG

RAMBOLL ENVIRON

Onshore Sources

- **Combustion Sources**
  - Power plants
  - Fuel combustion
  - Waste burning, WWT
  - Gasoline refueling
- **Methods & Data:**
  - 2011 NEI
  - WebFIRE emission factors
  - Fuel, waste, WW effluent quantities: local sources, NSB Public Works



- **On/Nonroad Sources**
  - Dalton Hwy, TAPS patrols, within Prudhoe Bay oil fields
  - Idling
  - Snowmobiles, ATVs
  - Unpaved road dust
- **Methods & Data**
  - Emission factors: MOVES2014, 2011 NEI ADEC inputs
  - VMT for Barrow, scaled
  - NONROAD2008a
  - AP-42, Dalton Hwy silt content

BOEM Bureau of Ocean Energy Management

ERG

RAMBOLL ENVIRON

Airports

Emission Sources

- 16 designated airports
- Fixed wind, helicopters for commercial and general aviation
- Auxiliary Power Units (APUs)
- Ground Support Equipment (GSE)

Methods & Data

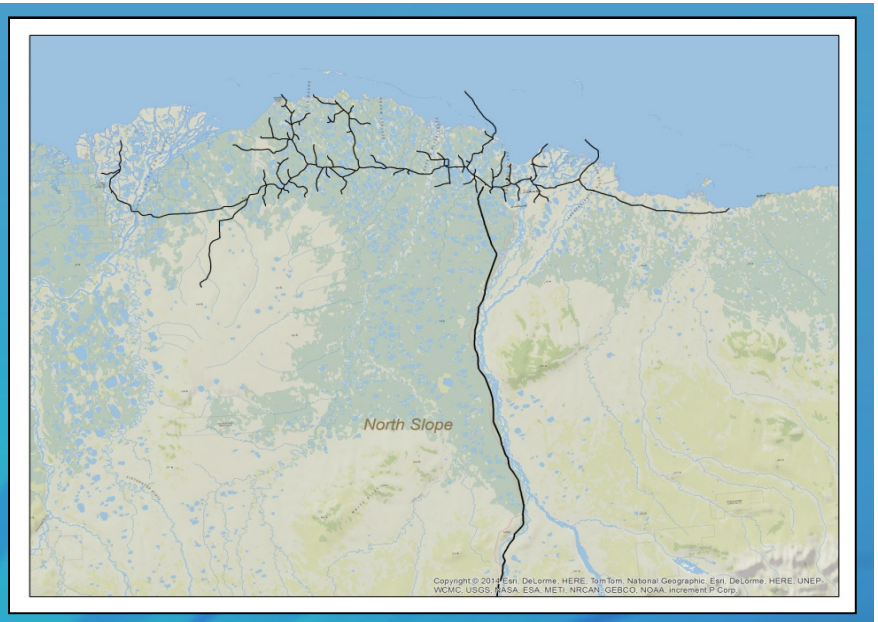
- EDMS
- Landing and Take-off (LTO) cycle data from local sources
- FAA/EPA LTO data in place of enplanement data from local sources

BOEM Bureau of Ocean Energy Management

ERG

RAMBOLL ENVIRON

Trans-Alaska Pipeline System (TAPS)



Emission Sources

- Pump stations
- Fugitives
- Pigging operations
- Pipeline replacement, repair
- (On-road and aerial surveillance)

Methods & Data

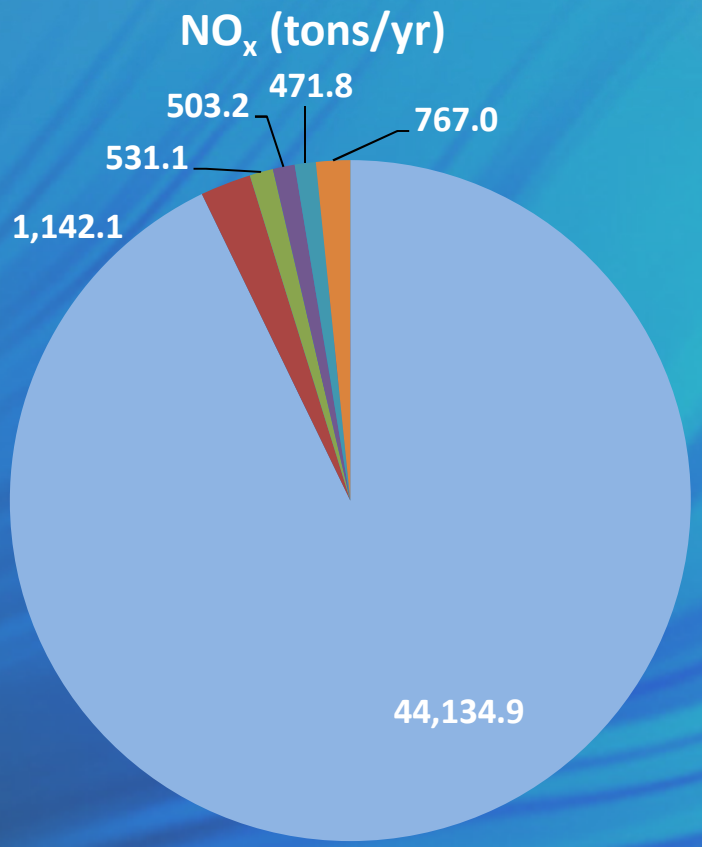
- Pump stations: U.S. NEI
- Fugitives: National production-based emission factors, scaled miles of pipeline
- Pigging: Methane-to-Markets guidance

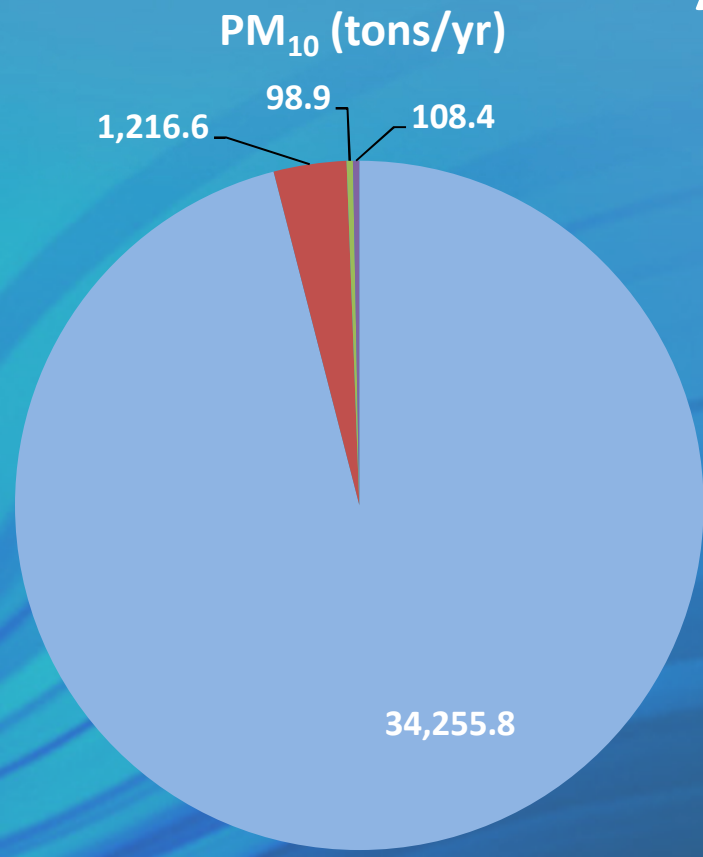
BOEM Bureau of Ocean Energy Management

ERG

RAMBOLL ENVIRON

Results – Baseline Emissions Inventory





Oil and Gas - Onshore
Oil and Gas - Offshore
Other Facilities
Research Vessels
Electricity Generating Facilities
All Other

Unpaved Roads
Oil and Gas - Onshore
Waste Incineration, Combustion, and Landfills
All Other

BOEM Bureau of Ocean Energy Management

ERG

RAMBOLL ENVIRON

Baseline Emissions Inventory tons/year

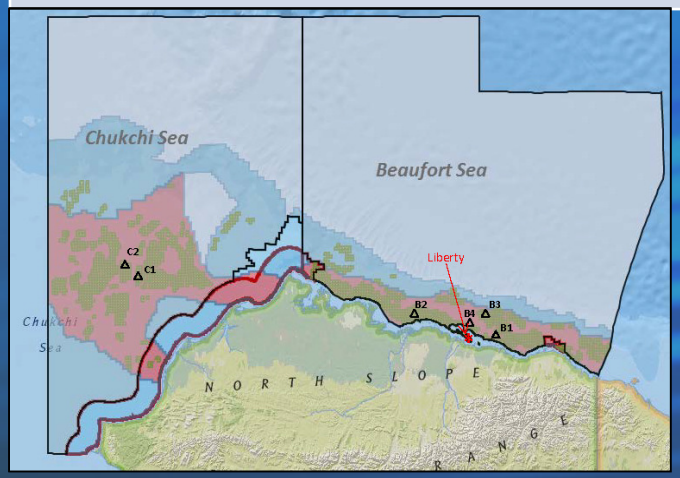
Sector	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$
Offshore	1,816	38	106	249	36	27
Onshore	45,734	1,235	2,886	14,002	35,644	4,771
Total	**47,550**	**1,273**	**2,992**	**14,251**	**35,679**	**4,798**

Sector	CO_2	CH_4	N_2O	CO_2e	HAP	H_2S
Offshore	139,983	1	7	141,933	18	1
Onshore	$13.6x10^6$	8,792	29	$13.8x10^6$	390	4
Total	**$13.7x10^6$**	**8,793**	**36**	**$13.9x10^6$**	**408**	**5**

BOEM Bureau of Ocean Energy Management ERG RAMBOLL ENVIRON

Emissions Inventory Projections

BOEM Full Build-Out Scenario (Potential Production)		
Activity	**Beaufort Sea**	**Chukchi Sea**
Production: Gas	167 BCF/yr	115 BCF/yr
Production: Oil, Condensate	132 MMbbl/yr	204 MMbbl/yr
No. of Platform Wells	215 Wells	260 Wells
No. of Subsea Wells	34 Wells	90 Wells



Projected offshore development areas

BOEM Bureau of Ocean Energy Management

ERG

RAMBOLL ENVIRON

Projected Emission Changes Expected Under Hypothetical Full Build-Out Scenario

- Offshore Sources
  - Seismic surveys
  - Exploratory drilling
  - Pipelaying and support vessels
  - Platform construction, operation
  - Spills
- Onshore Sources
  - New oil and gas production facilities
  - New pipeline construction, operation
  - Liberty Island construction and drilling
  - New exploration base, air support base, search and rescue base
  - Increased TAPS throughput, air traffic
  - ULSD in all sources

BOEM Bureau of Ocean Energy Management ERG RAMBOLL ENVIRON

Emissions Inventory Projections, tons/year Increases

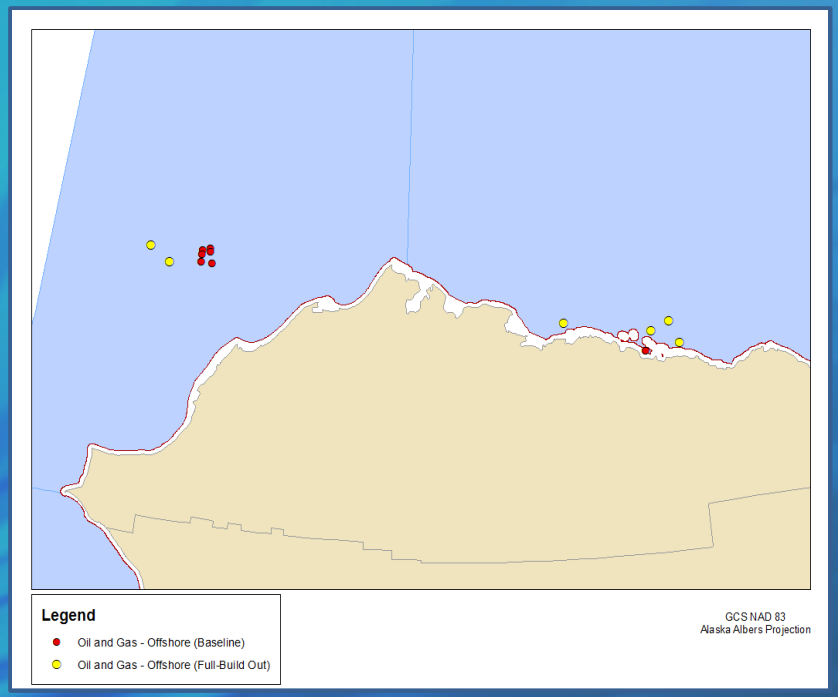
Sector	NO_x	SO_2	VOC	CO	PM_{10}	$PM_{2.5}$
Offshore	14,436	1,330	771	3,013	348	294
Onshore	17,068	341	894	7,408	953	879
Total	**31,504**	**1,671**	**1,665**	**10,421**	**1,300**	**1,173**

Sector	CO_2	CH_4	N_2O	CO_2e
Offshore	2.8×10^6	125,994	424	6.1×10^6
Onshore	18.4×10^6	26,601	77	19.0×10^6
Total	**21.2×10^6**	**152,595**	**501**	**25.1×10^6**

BOEM Bureau of Ocean Energy Management ERG RAMBOLL ENVIRON

Near-Field Atmospheric Dispersion Modeling (ADM)

- **Objective:** Quantify the air quality impacts of individual sources within the modeling domain
- **Method:**
  - AERMOD to model sources within ~50km of shoreline
  - Conservatively high assumptions (e.g., full NO to NO_2 conversion)



BOEM Bureau of Ocean Energy Management ERG RAMBOLL ENVIRON

ADM Results

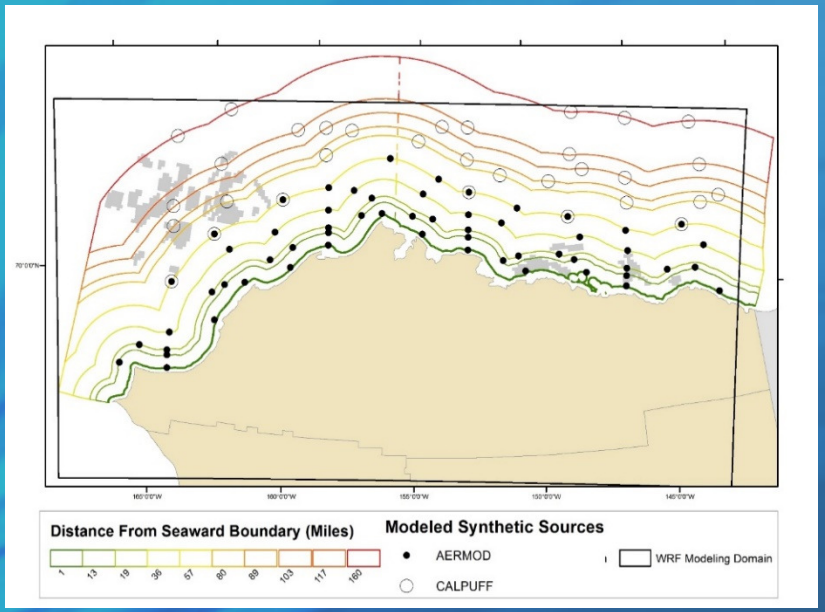
- Impacts were minor for most sources, pollutants
- Some 1-hr NO2 results exceeded the SIL, but are a small percentage of the NAAQS and unlikely to cause a violation

Pollutant	Inventory	Percentage of NAAQS		
		1-Hour	24-Hour	Annual
CO	Baseline	[<1%]	--	--
	Full Build-Out	[<1%]	--	--
NO_2	Baseline	[4.90%]	--	[<1%]
	Full Build-Out	[<1% - 4.90%]	--	[<1%]
PM_{10}	Baseline	--	[<1%]	--
	Full Build-Out	--	[<1%]	--
$PM_{2.5}$	Baseline	--	[<1%]	[<1%]
	Full Build-Out	--	[<1%]	[<1%]
SO_2	Baseline	[<1%]	[<1%]	--
	Full Build-Out	[<1%]	[<1%]	--

BOEM Bureau of Ocean Energy Management ERG RAMBOLL ENVIRON

Emission Exemption Threshold (EET) Evaluation

- **Objective**
  - Review of the existing formulas to ensure they are still an appropriate under current NAAQS
- **Method**
  - Modeled "synthetic sources" with AERMOD and CALPUFF
  - Compared the modeling results to the significant impact levels to determine if there is significant impact for that averaging time/NAAQS
  - Compared modeling outcome to the result of the EET



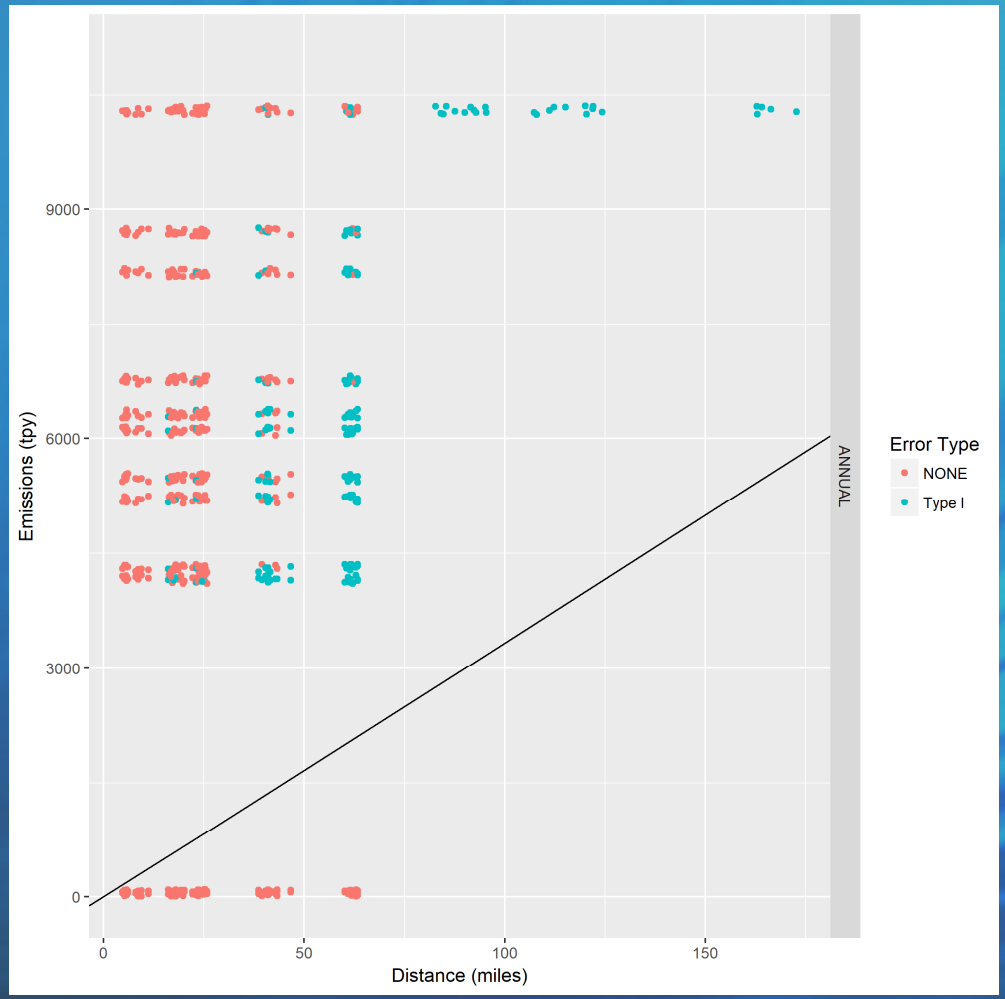
AERMOD and CALPUFF Modeling Locations

BOEM Bureau of Ocean Energy Management

ERG

RAMBOLL ENVIRON

EET Modeling Evaluation



- For most annual standards, existing EET formulas appear conservative (i.e. false positive rate ≈ 4-15%)
- For short-term standards, the formulas have a "miss" rate ≈ 5-20%

BOEM Bureau of Ocean Energy Management

ERG

RAMBOLL ENVIRON

BOEM Arctic Air Quality Modeling Study - Summary

- 5-Year study to examine air quality effects from potential future oil and gas exploration and production on the Arctic OCS
- Development of bottom-up emissions inventory of all sources: stationary, mobile, on- and offshore
- Development of detailed meteorological and air quality modeling
- Evaluation of BOEM's exemption thresholds
- No to low adverse effects indicated from future activities based on potential full-buildout scenario

BOEM Bureau of Ocean Energy Management

ERG

RAMBOLL ENVIRON


THANK YOU!
Paula.Fields@erg.com
916-635-6593
BOEM
Bureau of Ocean Energy Management
ERG
RAMBOLL
ENVIRON