1990 – 2020 Alaska Greenhouse Gas Inventory & Forecast

Presentation to
Alaska Mitigation Advisory Group
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Overview

- Greenhouse Gas Pollutants and Emission Basics
- Alaska Emission Inventory & Key Source Sectors
- Refinements to the Inventory
- Recommendations and Potential Future Efforts
- Where to Get More Information

Greenhouse Gas Pollutants & Emission Inventory Basics

Major Greenhouse Gases & Global Warming Potential

Greenhouse Gas	**Global Warming Potential**
Carbon dioxide CO_2	1
Methane CH_4	25
Nitrous oxide N_2O	298
Sulphur hexafluoride SF_6	22,800
Hydrofluorocarbons HFCs	range 794-14,800
Perfluorocarbons PFCs	range 7,390-12,200

GWP = Global warming potentials the ability of different greenhouse gases to trap heat in the atmosphere. GWPs are calculated relative to that of carbon dioxide (CO_2).

(IPCC Fourth Assessment Report, 2007)

Greenhouse Gas Emission Inventory Defined

- The greenhouse gas emissions inventory identifies sources of greenhouse gases from human activities
- Natural sources have not typically been the focus of emission inventory efforts
- The inventory calculates greenhouse gas emissions over a defined period of time – usually a year
- Results are provided in a report documenting methods and data used to prepare the estimates
- Emission calculations are estimates and thus uncertain
- Allows for identifying and understanding key sources

Sources of Greenhouse Gases

Anthropogenic Sources

- Energy Sector
  - Burning of fossil fuels for power, heat and electricity (carbon dioxide, methane, nitrous oxide).
- Industrial Sector
  - Electronics, mineral, metal, chemical pulp & paper manufacturing (SF_6, PFCs, HFCs)
- Agriculture, Forestry & OLU
  - Livestock & crop production, controlled burning of grass & forest land (methane, nitrous oxide)
- Waste Disposal
  - Solid waste landfills, open burning & incineration, wastewater treatment plants.

Natural Sources

- Forest fires, volcanoes, tundra
  - Alaska's tundra stores large amounts of methane that could be released if thawed

Greenhouse Gas Inventory Methods

- The Intergovernmental Panel on Climate Change and EPA have developed methods
- GHG's are usually reported in million metric tons of CO_2 equivalents ($MMTCO_2eq$)
- $MMTCO_2eq$ = Activity Data (fuel use) x Emission Factor (EF)
- The Emission Factor incorporates all potential GHG for the fuel used

<u>Example Calculations</u>

- $MMTCO_2eq$ = {gals. Diesel} * {CO_2EF + 25*CH_4EF + 298*N_2OEF}
- Total Emissions ($MMTCO_2eq$) = $MMTCO_2$eq diesel + $MMTCO_2$eq natural gas + $MMTCO_2$eq gasoline, etc.

Alaska Emission Inventory & Key Source Sectors

Alaska's Greenhouse Gas Emissions Inventory

- The Center for Climate Strategies (CCS) February 2007 report was the first comprehensive inventory of Alaska's GHG emissions.
  - Historical emissions from 1990 to most recent year
  - Projections to 2020
  - Preliminary analysis for further discussion and revision
- GHG's were quantified for 6 major sectors:
  - Electricity; Fossil Fuels; Residential, Commercial & Industrial; Transportation; Industrial Processes; Waste Management, Forestry, and Agriculture.
- Based on ADEC suggestions and comments, CCS provided an updated report in July 2007.

CCS GHG Emissions Inventory Conclusions

- 2005 Total GHG Emissions in Alaska
  - 43 MMT CO_2eq in 1990
  - 52.1 MMT CO_2eq in 2005
  - 62 MMT CO_2eq in 2020
- Alaska's 2005 GHG emissions were 0.7% of the total US GHG emissions.
- Alaska's GHG emissions grew 13% from 1990 to 2000, while US emissions grew 14% during this same period.
- Residential, Commercial, Industrial sources in Alaska accounted for 49% of the total state GHG emissions in 2005.
- Industrial fuel use accounted for nearly 85% of the RCI fuel use emissions.
- Transportation Sources accounted for 37% of the total state GHG emissions (later refinements show aviation accounts for ~68% of transportation sector).

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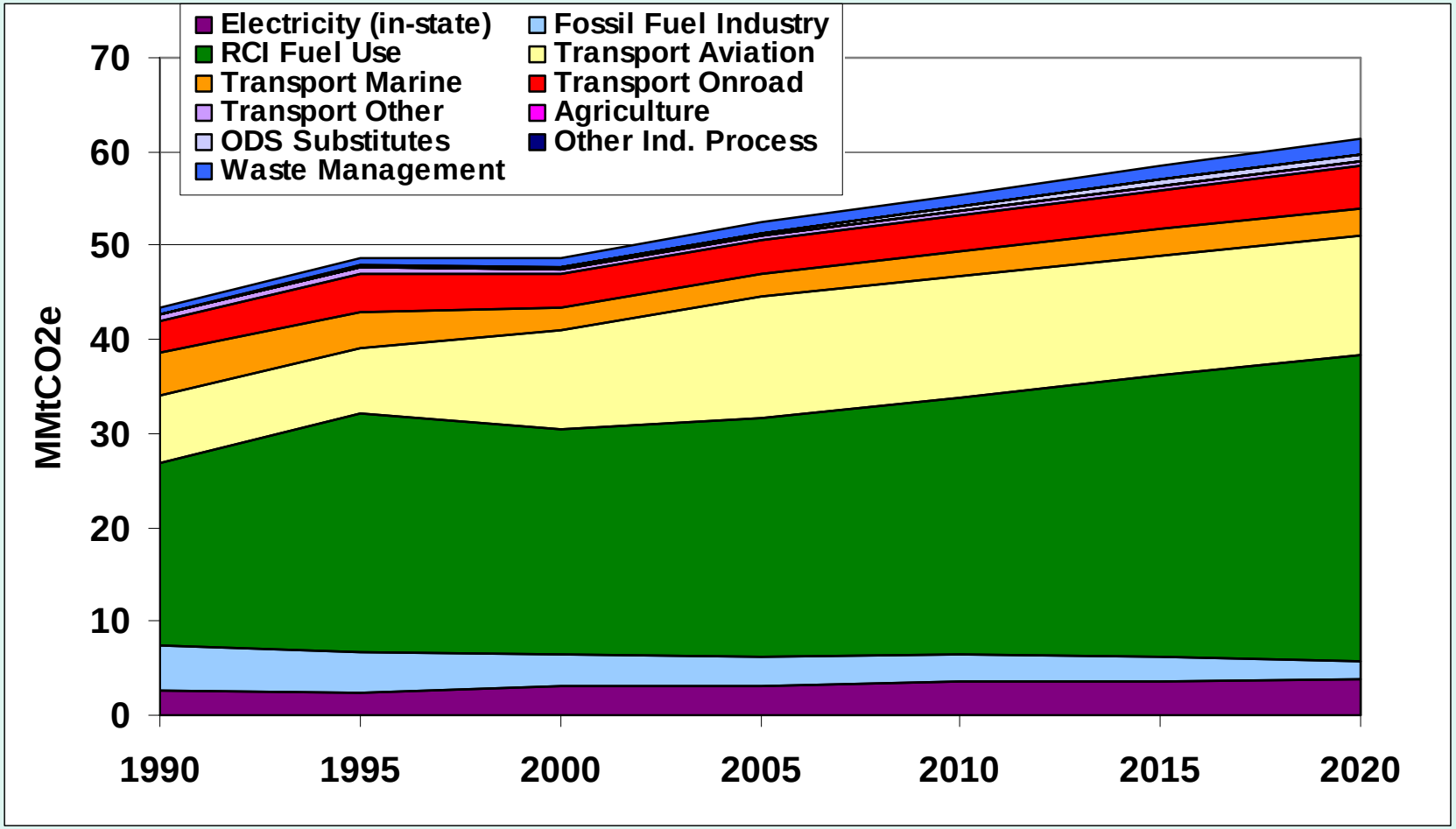
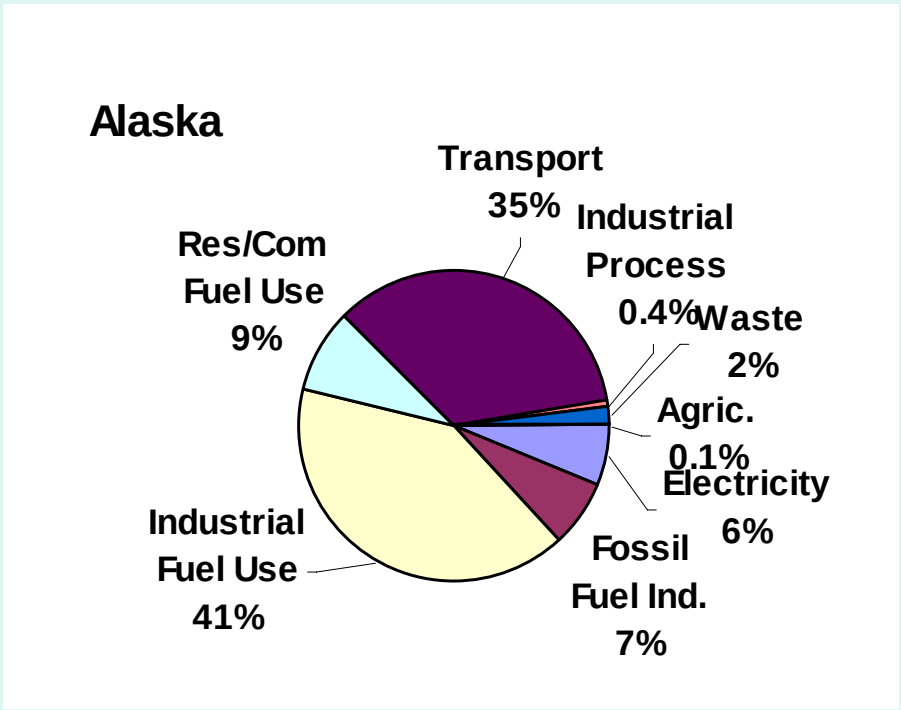
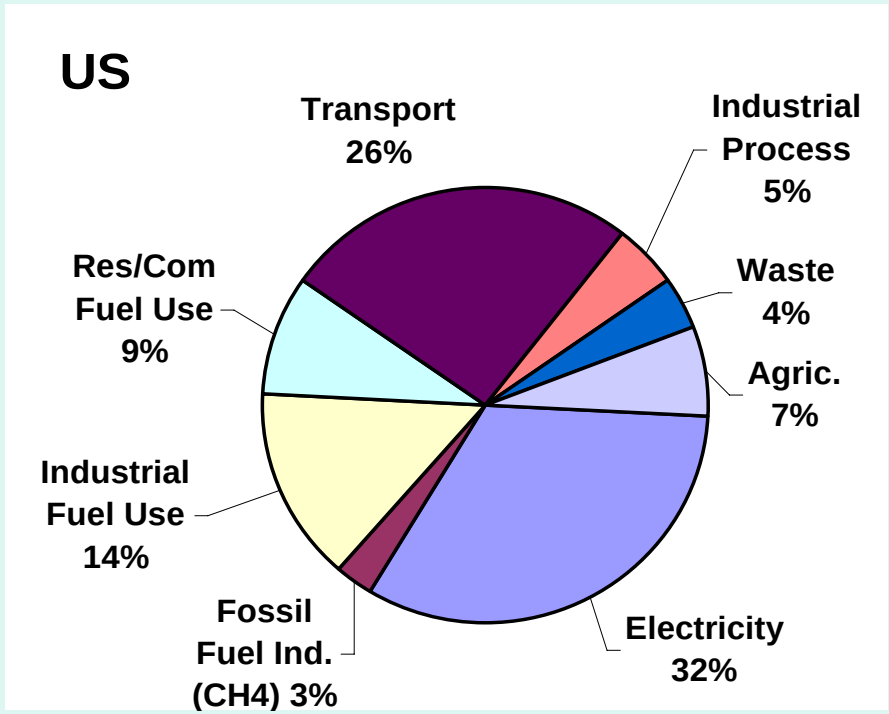
Gross Alaska GHG Emissions By Sector, 1990-2020



Alaska & US Emissions By Sector, Year 2000





Greenhouse Gas Emission Inventory Refinements

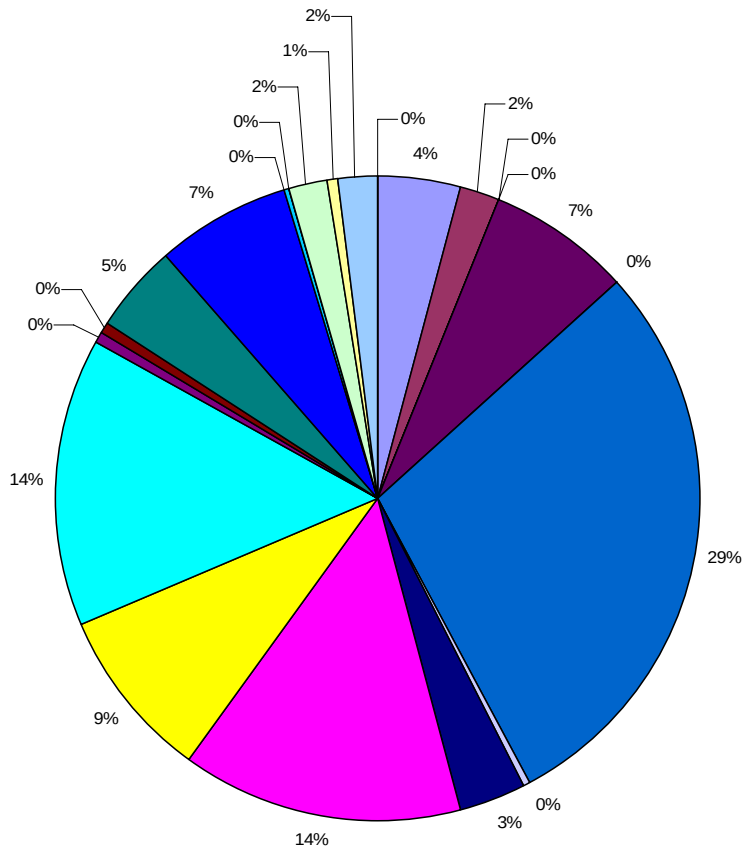
ADEC Refinements
Alaska's GHG Emission Inventory

- In March 2007, Trustees for Alaska requested ADEC require large emitters of GHG to quantify & report their emissions.
- ADEC committed to refine the GHG emission estimates for major industrial and transportation sources.
- ADEC conducted GHG emissions inventory for Title V (major) air permits in Alaska using 2002 fuel usage data.
- ADEC contractor, E.H. Pechan, also conducted a refined GHG emissions inventory for the air transportation industry.

ADEC Refinements
GHG Emissions Inventory Results for 2005
($MMTCO_2eq$)

Source Group	$MMTCO_2e$	Percentage
Total Electricity Production	**3.2**	**6%**
Total Residential & Commercial	**3.9**	**7%**
Total Industrial	**24.6**	**47%**
Total Transportation	**18.8**	**36%**
Total Waste Management	**1**	**2%**
Industrial Processes	**0.3**	**1%**
Military - Title V	**0.97**	**2%**
Agriculture	**0.05**	**0.1%**
Total Gross Emissions	**52.82**	

Estimated Percent Contribution of GreenHouse Gases

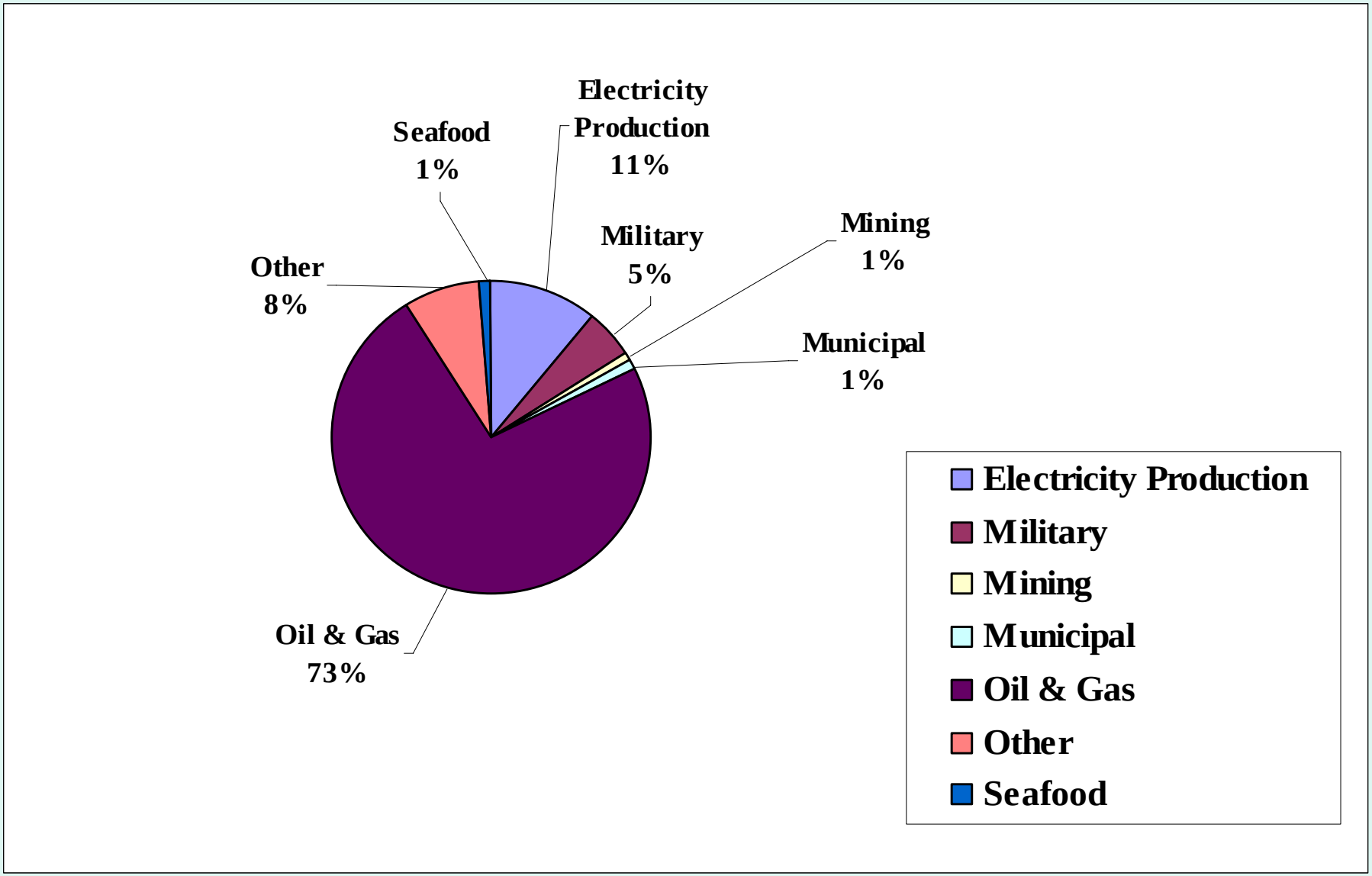


- Electricity Production - Title V (4%)
- Electricity Production - Non-Title V (2%)
- Residential & Commercial - Title V Municipal (0%)
- Residential & Commercial - Title V Other (0%)
- Residential & Commercial - Non-Title V (7%)
- Industrial - Title V Mining (0%)
- Industrial - Title V Oil & Gas (29%)
- Industrial - Title V Seafood (0%)
- Industrial - Title V Other (3%)
- Industrial - Non-Title V (14%)
- Transportation - Aviation - Commercial - Domestic (9%)
- Transportation - Aviation - Commercial -International (14%)
- Transportation - Aviation - General Aviation (0%)
- Transportation - Aviation -Military (0%)
- Transportation - Marine Vessels (5%)
- Transportation - On-road Vehicles (7%)
- Transportation - Rail & Other (0%)
- Waste Management - Title V (0%)
- Waste Management - Non-Title V (2%)
- Industrial Processes (1%)
- Military - Title V (2%)
- Agriculture (0)

ADEC Title V GHG Emissions Inventory Results

ADEC Source Category	GHG Emissions ($MMTCO_2eq$)	Percentage of Total GHG Emissions
Electricity Production	2.18	11%
Military	0.97	5%
Mining	0.017	1%
Municipal	0.012	1%
Oil & Gas	15.26	73%
Other	1.76	8%
Seafood	0.16	1%
Totals	20.63	100%

ADEC Title V GHG Emission Inventory Results



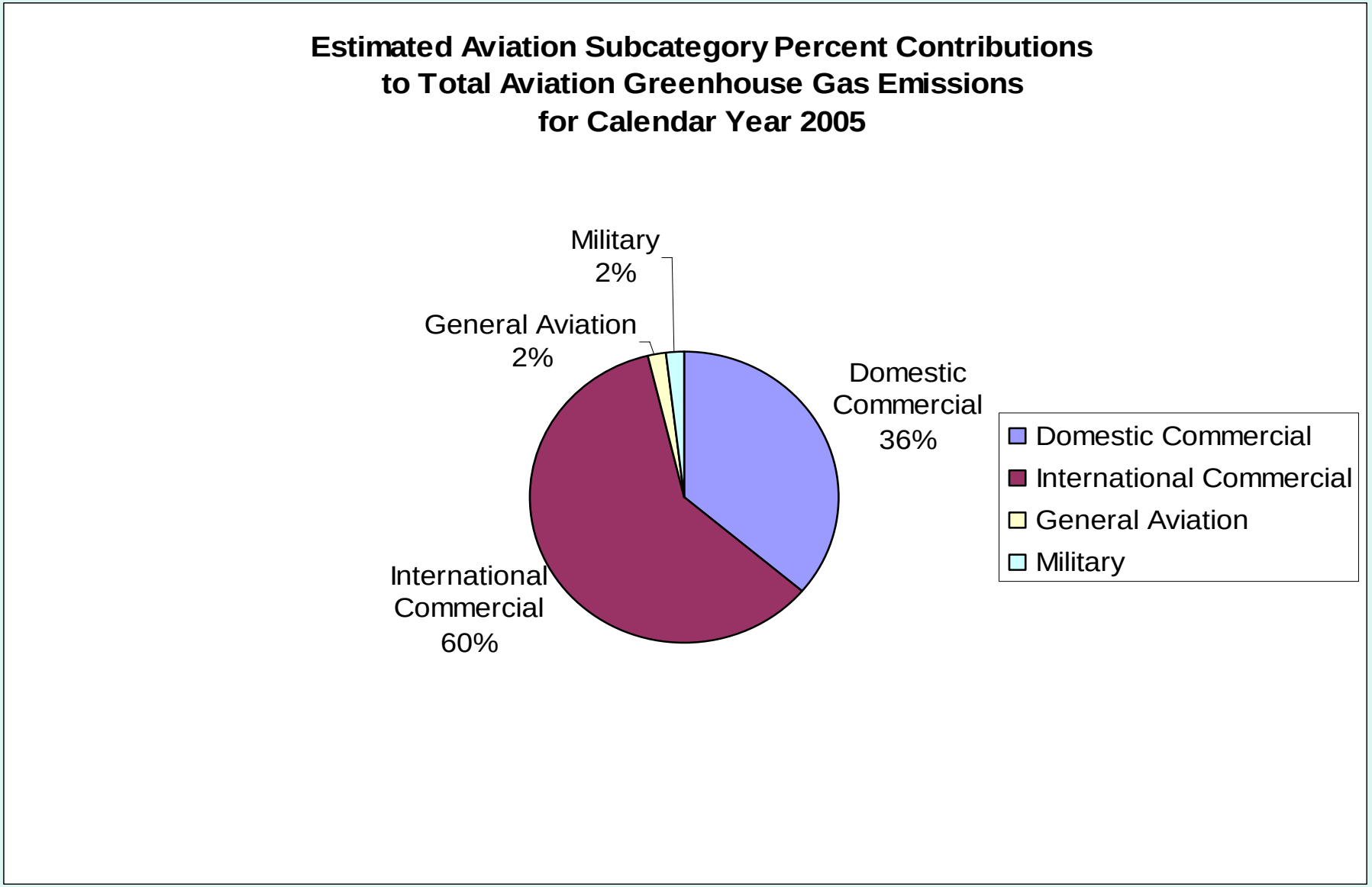
ADEC Title V GHG Emission Inventory Discussion

- Title V sources with the highest GHG emission estimates:
  - BP Exploration (10.67 MMTCO2e)
  - Conoco Phillips (2.405 MMTCO2e)
  - Agrium US (1.737 MMTCO2e)
  - Chugach Electric Association (1.070 MMTCO2e)
  - UNOCAL (0.746 MMTCO2e).
- Sources with the highest percentage of GHG emissions:
  - Oil & Gas (73%)
  - Electricity Production (11%)
  - Other (8%) – (Agrium US, Alaska Railroad Corporation and Capitol Disposal were grouped into the “Other” source category)
  - Military (5%)
- ADEC Title V GHG emission inventory includes fuels stored in fuel terminals and transported in the Alaska pipeline, and fuels combusted in Alaska during 2002.

ADEC Refinements
Aviation GHG Emission Estimates

- CCS found the aviation subcategory had the largest share of GHG emissions from Alaska's transportation sources (aviation, marine vessels, on-road vehicles, railroads).
- Aviation is categorized into: commercial (international, domestic, cargo flights); general aviation (private aircraft, fleets); military (Alaska's military bases).
- E.H. Pechan determined that commercial aviation contributes about 96% of the total GHG emissions for the aviation industry.
- ADEC performed an analysis of the commercial aviation industry to determine what percent of the GHG emissions were due to domestic vs. international flights.

ADEC Analysis of Aviation GHG Emissions



Alaska's GHG Emission Inventory
Major Findings

- In 2005, total GHG emissions for Alaska = 52.8 MMtCO2e.
  - This amount equals about 0.7% of total US gross GHG emissions
- Residential, commercial, and industrial (RCI) fuel use accounts for 49% of total state gross GHG emissions in 2005.
- Nearly 85% of the RCI fuel use emissions are contributed by the industrial fuel use subcategory.
- The industrial subcategory accounts for around 41.5% of the gross GHG emissions in Alaska.
- Alaska's electricity production accounts for about 6% of Alaska's total GHG emissions.
  - Power generation is a major source of greenhouse gas emissions for many states.

Alaska's GHG Emission Inventory
Major Findings

- Transportation sources accounted for approximately 36.5% of the gross GHG emissions in Alaska.
- Jet fuel consumption accounted for the largest share of the transportation GHG emissions in Alaska.
- Commercial aviation likely accounts for 96% of aviation's contribution to GHG emissions in the transportation source category.
- International aviation, primarily cargo planes and a sub-division of commercial aviation, appears to account for about 60% of emissions from aviation sources.
- Cars and trucks and other "mobile" sources account for around 7% of total emissions in Alaska.
  - The percentage can be much higher in other states.

Recommendations & Potential Future Work

Recommendations for Future GHG Emission Inventories

- Further refine sector contributions as needed for decision-making
- Further refine GHG emission estimates for Alaska's energy sector
- Further refine aviation emission estimates using improved fuel combustion data and emission factors
- Analyze the contribution of natural sources of GHG
- Revise projections to address new rules and initiatives for projections
- Develop projection scenarios to analyze options for mitigation
- Adopt a standardized protocol to incorporate the inventory of greenhouse gases into Alaska DEC's existing air quality emission inventory work

Where to Get More Information

Information and Contacts

- State Climate Change Web Site
  - http://www.climatechange.alaska.gov/doc-links.htm
  - Final report incorporating changes from comments coming soon!
- Alaska DEC contacts
  - Clint Farr: clint.farr@alaska.gov
  - Alice Edwards: alice.edwards@alaska.gov