

E.H. Pechan & Associates, Inc.

**Nine Ports in the 49<sup>th</sup> State:  
Commercial Marine Inventory  
for Alaska**

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# Objective

- ❖ Determine Types of Commercial Marine Vessels Calling at Select Ports in Alaska
- ❖ Collect Data to Characterize 2002 Vessel Activity
  - » Number of Ships
  - » Engine Characteristics
  - » Time-in-mode
- ❖ Develop Annual and Seasonal 2002 Port-Specific Emission Estimates
- ❖ Develop Projections for 2005 and 2018

# Alaska Ports in Study



# Vessel Categories - Ocean-Going

## ❖ Cargo Freight Ships

- » General Cargo
- » Container
- » Roll-On/Roll-Off
- » Tankers



# Vessel Categories - Ocean-Going

## ❖ Passenger Cruise Ships



## ❖ Towboats/Barges

# Vessel Categories - Harbor Vessels

## ❖ Ferries

- » Alaska Marine Highway System
  - commuter and tourist ferry

## ❖ Fishing Vessels

- » Commercial and Charter Boats

## ❖ Harbor Tugs



# Fishing Vessels and Tugs



# Activity Calculations

Activity calculated using the following equation:

$$Activity_{mode} = Power \times Load Factor \times Time_{mode} \times Calls$$

where:

<i>Activity<sub>mode</sub></i>	=	activity by mode (kilowatt [kW]-hours)
<i>Power</i>	=	rated engine power by vessel and engine type (kW)
<i>Load Factor</i>	=	load factor of the engine by vessel type and mode
<i>Time<sub>mode</sub></i>	=	time in mode per call by vessel type (hours)
<i>Calls</i>	=	number of port calls by vessel and engine type



# Activity Calculations

- ❖ Four activity modes
  - » Cruise
  - » Reduced-speed zone (RSZ)
  - » Maneuver
  - » Hotelling
- ❖ Account for In-Port and Underway Activity
  - » up to 25 miles outside of harbor area

# Ocean-Going Vessel Data

## ❖ 2004 Vessel Call Data

- » Calls by Port provided by the Marine Exchange of Alaska (MXAK)
- » 2002 Data Incomplete
  - 2004 backcasted to 2002 using MXAK adjustments
- » Data provided by
  - vessel type
  - engine type (diesel or steam)
  - engine size

# Ocean-Going Diesel Engine Assignments

- ❖ Not Specified in MXAK Database
- ❖ Medium-speed, diesel-electric
  - » Large cruise ships
  - » Tankers
  - » Roll-on/Roll-offs
- ❖ Slow-speed
  - » Small cruise ships
  - » Bulk carriers
  - » General cargo
  - » Container ships

# Ocean-Going Calculations by Port and Vessel Type

- ❖ Calculated Average Propulsion and Auxiliary Engine Power
- ❖ Developed Average Time-in-mode Values
  - » Used MXAK data for hotelling
  - » Data from EPA typical ports for cruising speed in 25-mile cruise zone
  - » RSZ and maneuvering times obtained from pilots for Dutch Harbor, Juneau, and Ketchikan
    - Other ports based on EPA procedures

# Ferry Activity Data

- ❖ Alaska Marine Highway System
  - » Compiled number of calls by port and vessel from ferry schedule
  - » Obtained engine horsepower and service speed
  - » Service speed used in cruise mode calculations

# Ferry Activity Data

- ❖ Times for Maneuvering and RSZ
  - » Estimated using EPA procedures
    - Maneuvering time assumed 1 hour per call
    - RSZ based on assumed round-trip distance of 10 miles, traveling at 65% of service speed
- ❖ Hotelling
  - » Estimated as 2 hours per call per the Marine Exchange of Alaska

# Fishing Activity Data

- ❖ Source: Alaska Dept of Fish and Game Commercial Fisheries Entry Commission
- ❖ Tracks receipts for fish tickets, for each landing made by licensed fishing vessel
- ❖ Provided total number of boats making fish landings at each port
- ❖ Provided vessel attribute database
  - » Matched on vessel license to estimate the number of vessels by fuel type and horsepower by port

# Fishing Activity Data

- ❖ Compiled vessel counts by port for charter fishing boats, also available from CFEC
- ❖ Available information on hours of operation per year not identified
  - » Many fisheries in Alaska, activity depends on length of fishing season, how long to catch quota
- ❖ Based on fishing vessel study in Midwest Region
  - 475 hours per year



# Fishing Activity Data – Dutch Harbor

- ❖ Vessel counts treated as calls since most fishing occurs beyond 25-mile limit
  - » Time-in-mode estimated similar to all ocean-going vessels
  - » Significant hotelling times, averaging 103 hours per call



# Emission Inventory – Load Factors

- ❖ Propulsion Engines
  - » EPA-recommended load factors developed for CMV rulemakings
    - Vary by vessel type and time-in-mode
- ❖ Auxiliary Engines
  - » Based on study performed by the Port of Los Angeles
    - Vary by vessel type and mode

# Emission Inventory – Emission Factors

- ❖ Propulsion and Auxiliary Engines by Vessel Type Assigned as Category 1, 2, or 3
  - » EPA Category 3 emission factors
    - Vary by vessel type, engine type and mode
  - » EPA Category 1 and 2 emission factors
- ❖ Gasoline Fishing Vessels
  - » Used NONROAD model data for recreational 4-stroke gasoline inboard engines

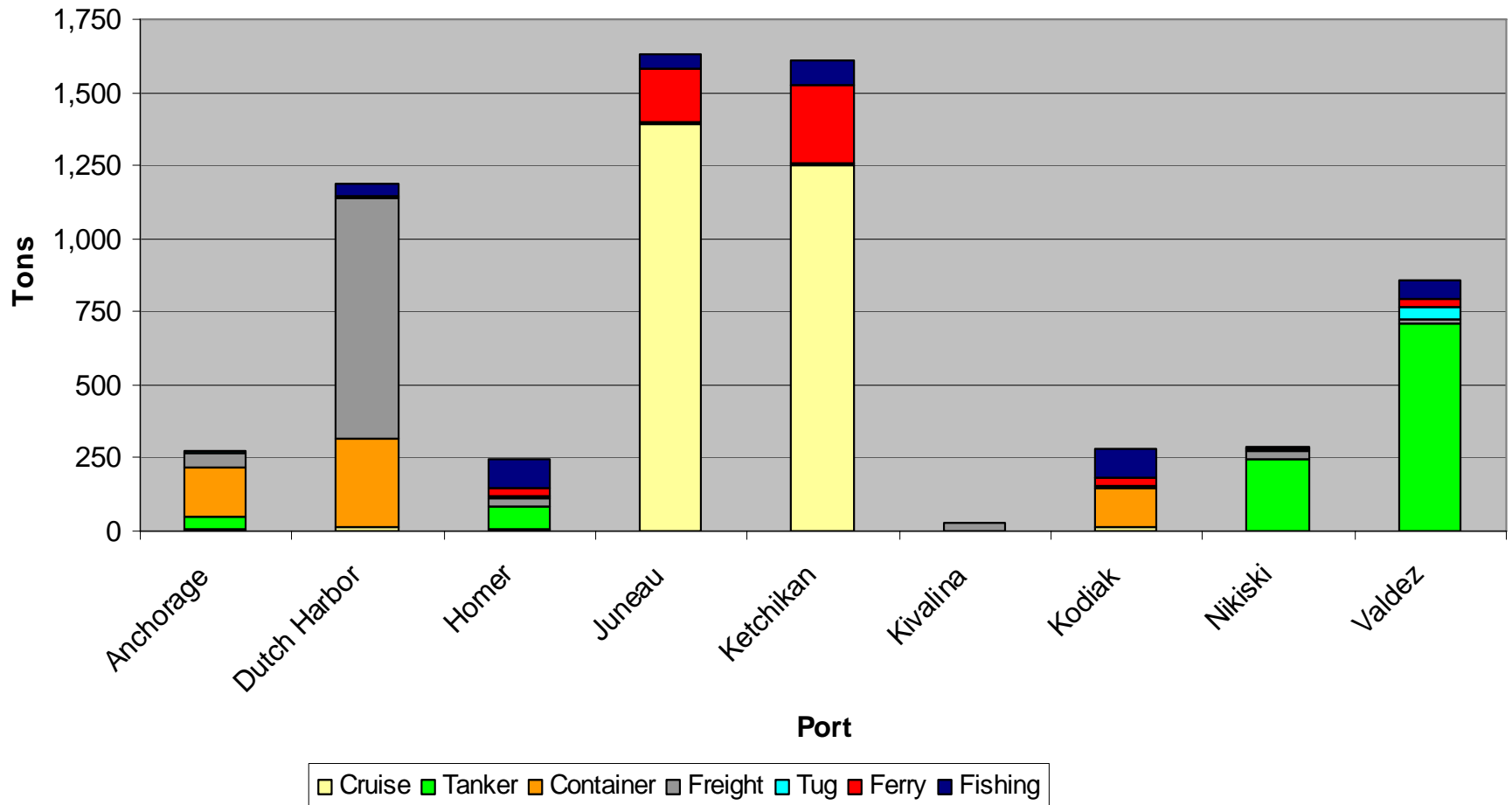
# Emission Inventory Calculations

- ❖ Calculated Annual Emissions by:
  - » multiplying activity in kW-hours by emission factors in grams per kW hours, convert to tons
- ❖ Summer and Winter Season Emissions
  - » Calculated based on seasonal calls by port and vessel type
- ❖ SCCs Assigned for Each Vessel Category
- ❖ Port Emissions Assigned to Boroughs (counties)

# 2002 Annual Emissions by Alaskan Port and Pollutant

Port	Borough	NOx	CO	SO2	PM25- PRI	VOC
Anchorage	Anchorage	277.1	67.9	202.5	23.8	7.4
Dutch Harbor	Aleutians West	1,185.4	187.1	307.5	42.7	19.3
Homer	Kenai Peninsula	247.9	206.2	72.0	7.8	15.2
Nikiski	Kenai Peninsula	285.8	48.4	128.7	13.4	4.5
Juneau	Juneau	1,631.3	254.1	839.8	114.0	53.5
Ketchikan	Ketchikan Gateway/Prince of Wales - Outer Ketchikan	1,611.2	460.9	754.7	101.2	58.3
Kivalina	Northwest Arctic	27.2	3.4	11.5	1.3	0.5
Kodiak	Kodiak Island	280.0	113.6	102.9	12.5	12.1
Valdez	Valdez-Cordova	859.5	299.7	584.6	64.5	23.4

# 2002 Annual NO<sub>x</sub> Emissions by Alaskan Port and Vessel Type

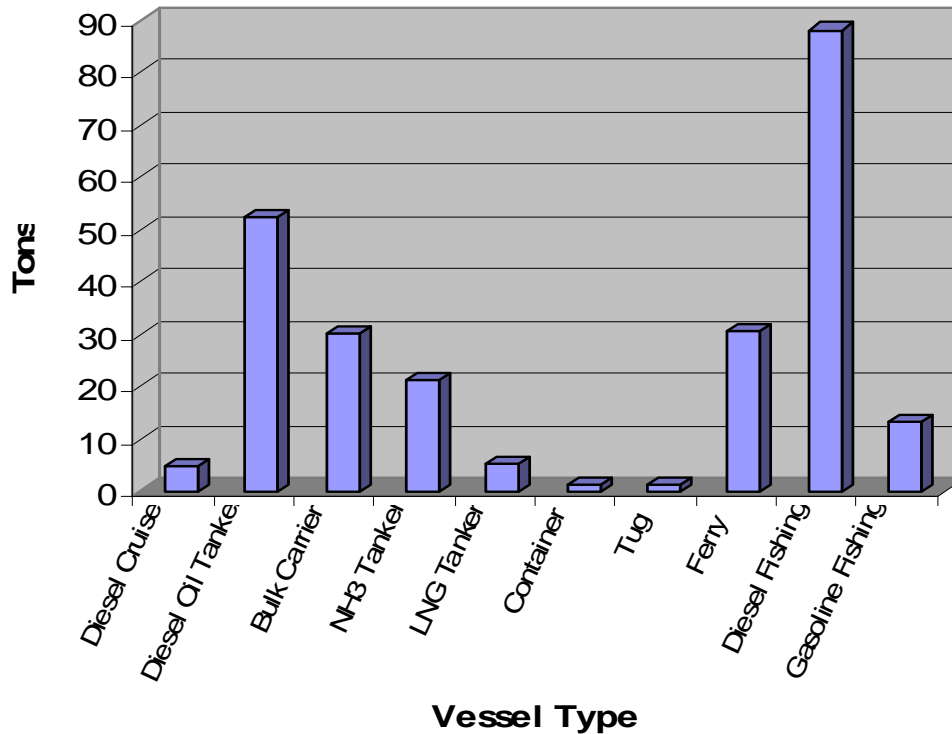


# Emission Inventory

## Main Contributors by Port

- ❖ Container and Freight Cargo Ships
  - » Anchorage, Dutch Harbor, Kivalina, and Kodiak
- ❖ Cruise Ships and Ferries
  - » Juneau and Ketchikan
- ❖ Tankers
  - » Homer, Nikiski, Valdez
- ❖ Fishing Vessels
  - » Homer, Kodiak
- ❖ Tugs
  - » Valdez has highest activity since 2 tugs assumed for each tanker call

# 2002 Annual NO<sub>x</sub> Emissions by Vessel Type for Homer





# Emission Projections – Growth Factors

- ❖ Cruise Ships
  - » Forecasts developed for Port of Ketchikan study, used for all other cruise ports
- ❖ Ocean-going Vessels and Tugs
  - » Linear extrapolations of historic national freight data from *Waterborne Commerce of the US*
- ❖ Ferries
  - » Based on Alaska State-level population forecasts
- ❖ Fishing Vessels
  - » Extrapolations of historic State total fish landings

# Emission Projections

- ❖ Projections Developed for 2005 and 2018
- ❖ All Categories showed Modest Growth in 2005
  - » Average growth factor of 1.1
- ❖ Continued Growth in 2018
  - » Average growth factor of 1.6
- ❖ Gas Turbine Cruise Ships
  - » Assumed constant per cruise lines
    - No plans to purchase new gas turbine ships in near future due to high cost of fuel to run turbine

# Recommendations

- ❖ MXAK Vessel/Engine Data
  - » Confirm engine assignments as slow versus medium speed
  - » Verify engine horsepower calculated from number of engines and available power
- ❖ Time-in-Mode Data Based on EPA Defaults
  - » Data needed from pilots during busiest time (June), and many could not fulfill request
  - » Actual data from pilot associations would improve activity and emissions

# Recommendations – Fishing Vessels

- ❖ Limited data on annual hours and areas of operation
- ❖ Survey likely needed to refine these data - Alaska fisheries are numerous and operation depends on fishery



# Recommendations

- ❖ Use of Shore Power (started in 2003) not accounted for in projections
- ❖ If shore power use increases, will result in decreased hotelling emissions

