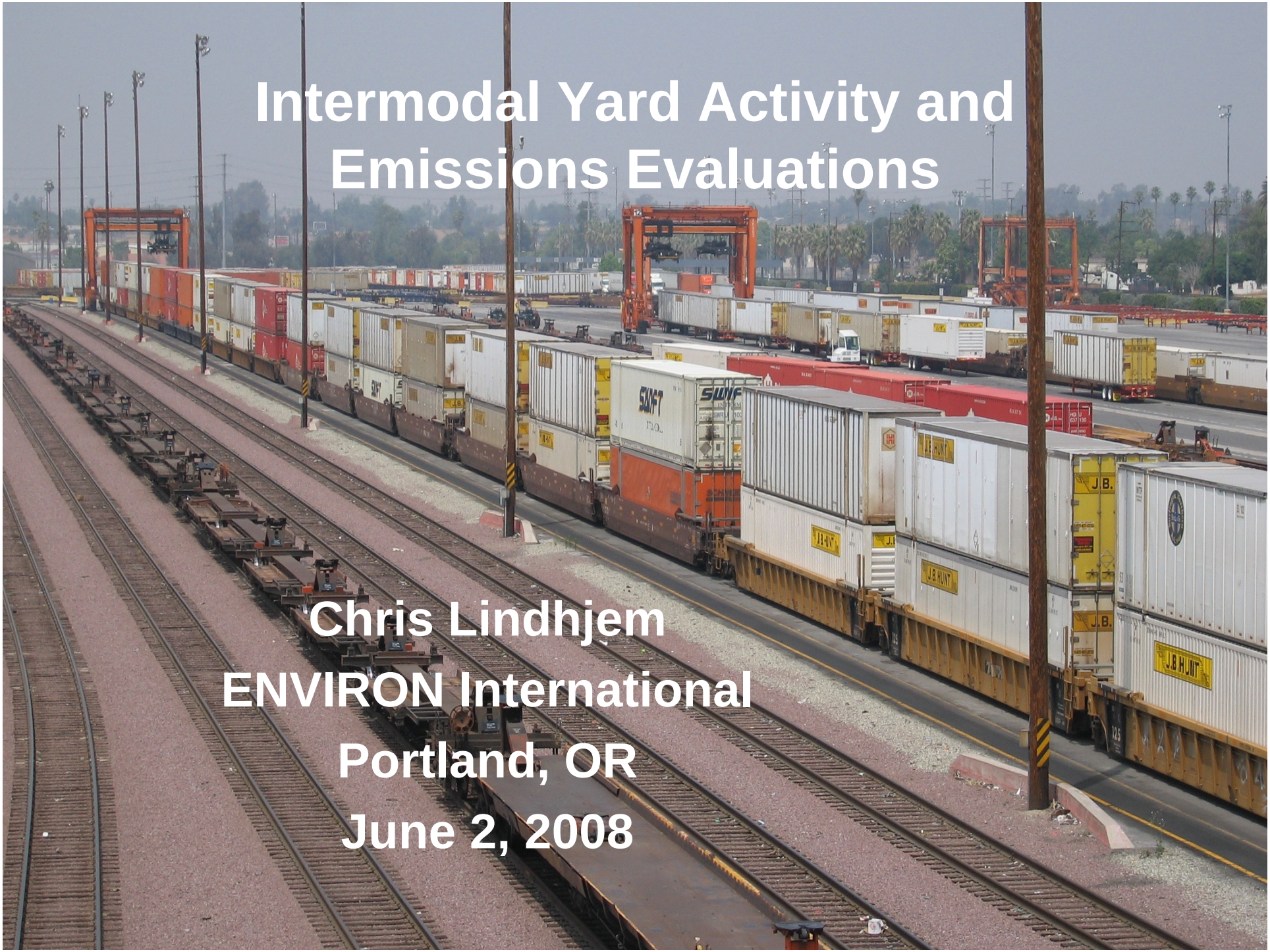

Intermodal Yard Activity and Emissions Evaluations

Chris Lindhjem
ENVIRON International
Portland, OR

June 2, 2008

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Overview

- **Intermodal Process**

Ship←→Crane ←→Hostler←→Crane/Pick←→Stack←→Crane/Pick←→Truck/Rail
OR Rail←→Crane/Pick←→Stack/Hostler←→Stack←→Crane/Pick←→Truck

- **Steps above may be skipped or electrified**
- **Basic measure of a facility's activity is lifts (individual container moves of 20 ft., 40 ft, 53 ft, or other lengths)**

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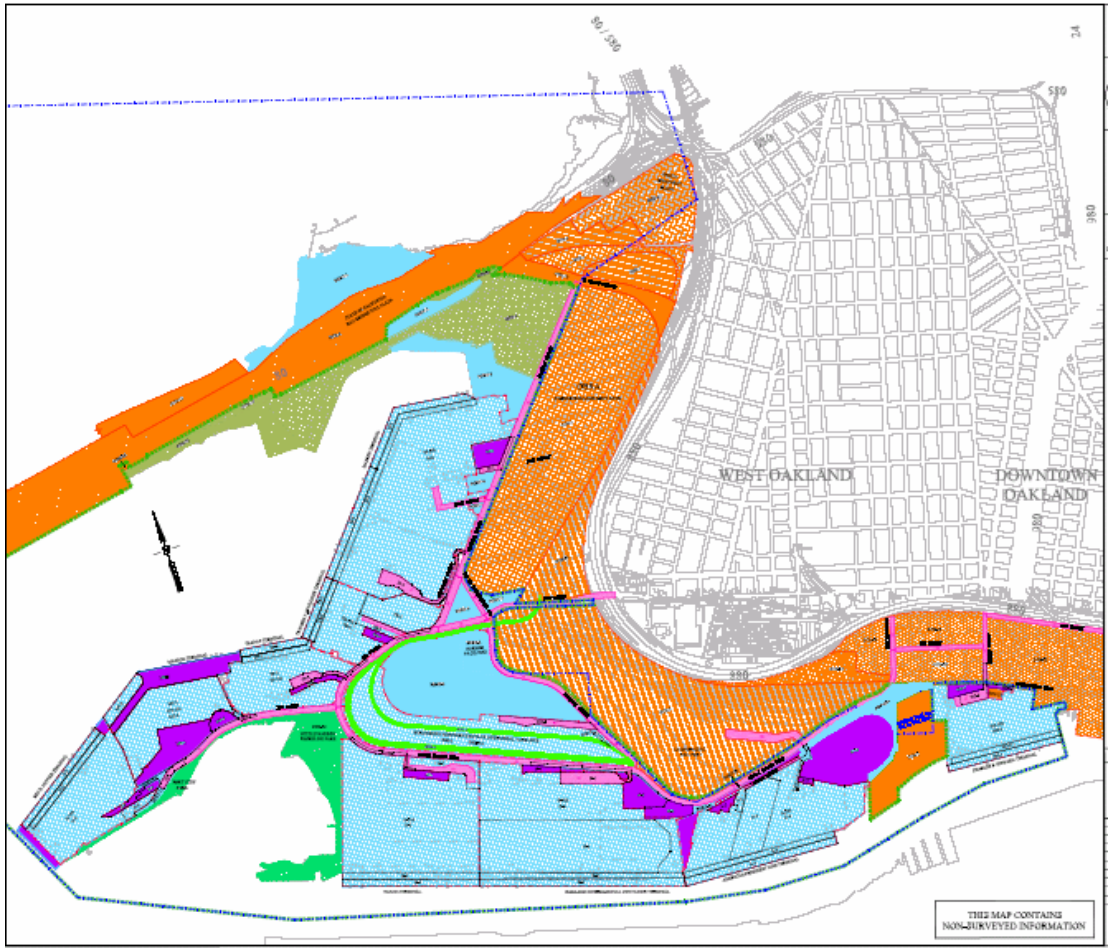
Intermodal Facility Evaluations

- **Purpose of Work**
  - Regional (overall emissions on site)
  - Local community (detailed or microscale as input in AERMOD or CALPUFF)



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Trucking Mode

- **Trucks**
  - Long-haul
  - Local (either to regional destination or repackaging sites)
  - Off-site (local off-site storage, or repositioning empty containers or chassis, or nearby port or rail yard)
- **Modes on site**
  - Loaded in and out
  - Loaded onto but empty out
  - Empty onto but loaded out
  - Empty container or chassis movements
  - Storage on site (truck in and truck out)
- **Truck Trips (round trips) may be higher or lower than 1 trip per lift. Our experience is 0.9 to 1.2 round trips (in and out) per lift.**

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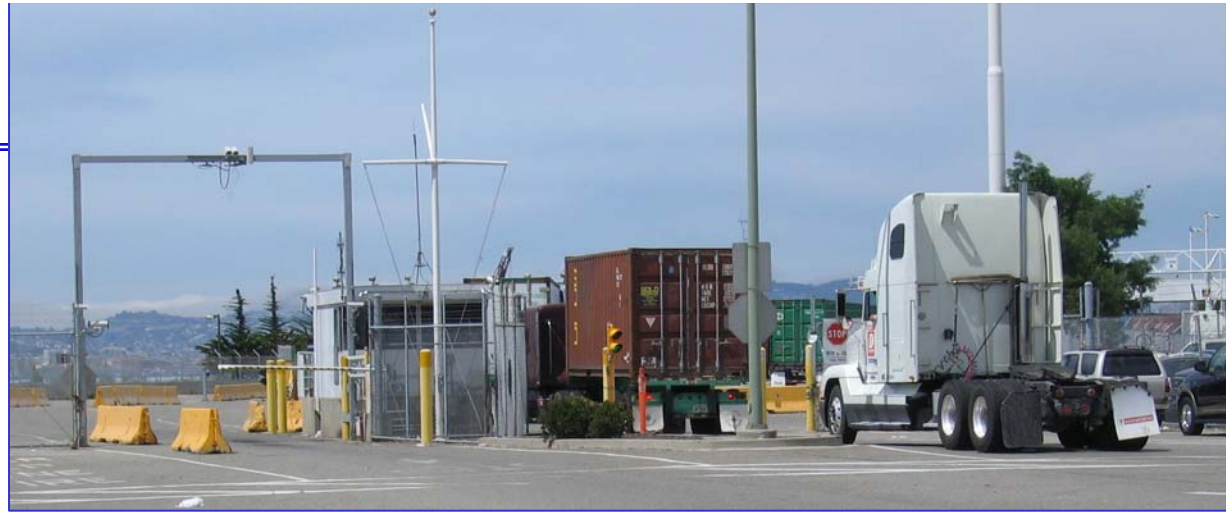
Truck Activity



- **On-site**
  - Entrance Queue
  - Movement and idling onsite
  - Exit Queue
- **Off-site**
  - Domain of the analysis (fence line, city, or air basin)
  - Origination and destination survey
  - Routes into and toward freeway and out of area
- **Age Distribution (short haul typically older vehicles) – 2007 / 2010 Vehicle emission standards**

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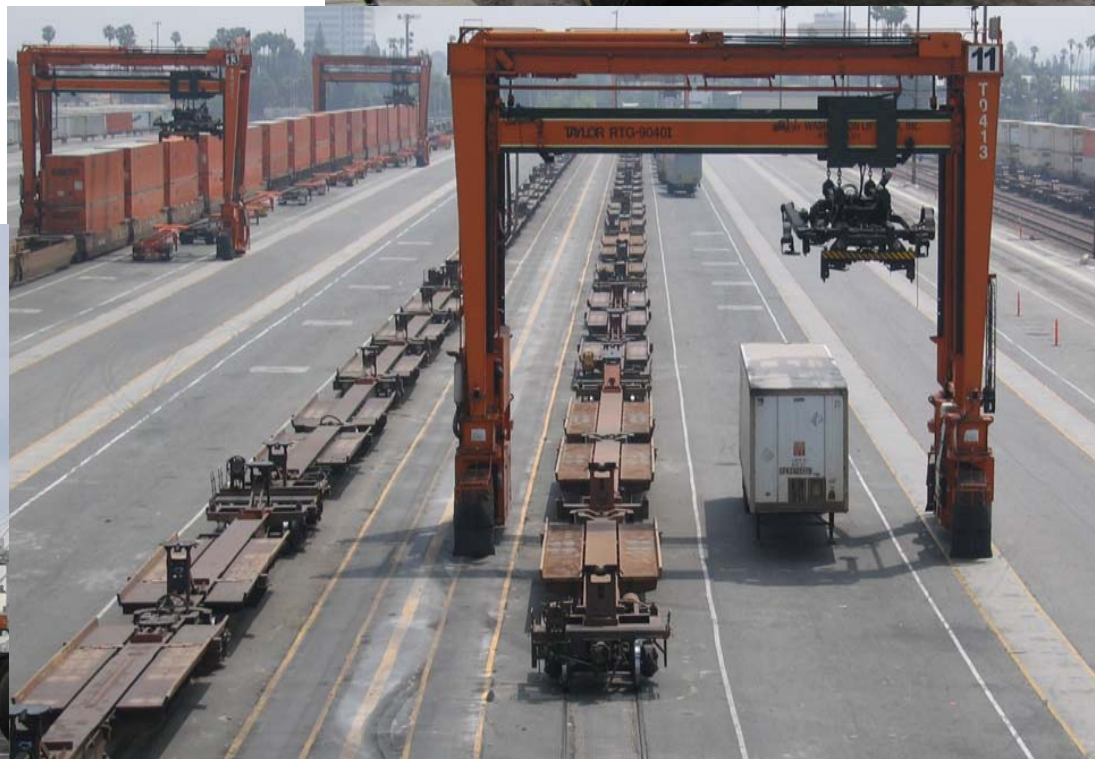
Cargo Handling Equipment

- **Container handling (dry bulk and liquid cargo uses other equipment types)**
  - Hostlers
  - Cranes (electric rail mounted or diesel rubber tired)
  - Picks and forklifts



CHE

- **CHE Input Data**
  - Population
  - Power
  - Model Year
  - Hours of operation
  - Load Factor (Duty cycle)
  - Fuel Type
  - Retrofits
- **Considerations**
  - Hours
    - Sample all equipment (function of use by age)
    - Snapshot of equipment fleet and annual hours may ignore pieces retired during that year
  - Load Factors
    - Worth determining actual loads and duty cycles
    - Not much real activity data behind default estimates

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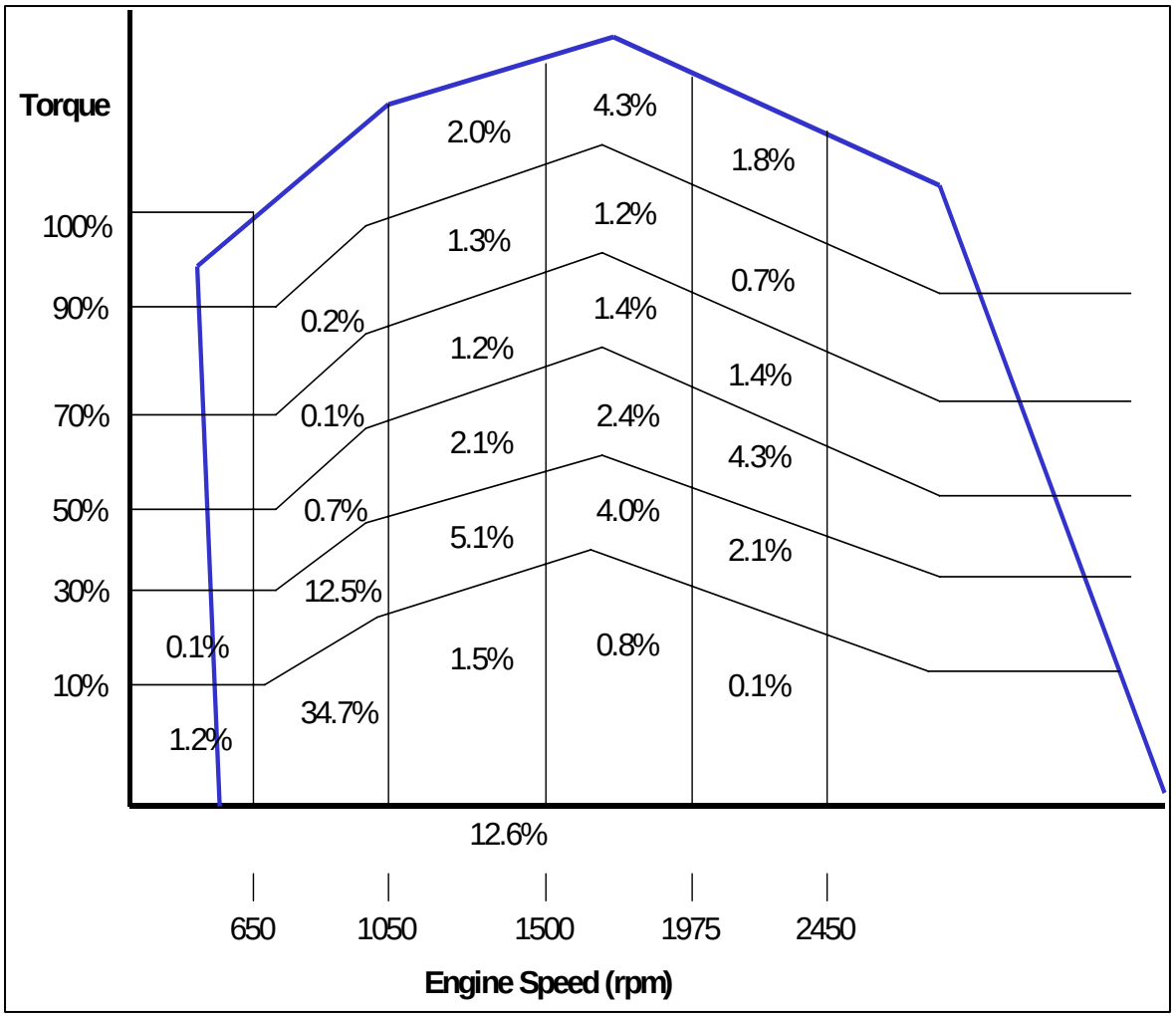
Hostler Load Factor

- **EPA default load for hostler is too high**
  - Study: actual load of 19%
  - EPA default for hostler is 59%



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Other Equipment Types

- **General purpose equipment (sweepers, pumps, generators, maintenance equipment, etc)**
- **Transport refrigeration units**
  - Surprisingly significant (California produce)
  - Number of and Time on site
  - TRU plugs to reduce activity

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Nonroad / Off-road Emission Standards

- **Federal Emission Standards**
  - New engine standards starting 2011 – 2012 depending upon the rated power of the equipment
- **California Regulations**
  - Retrofit / replacement voluntary and mandatory
  - Cargo handling equipment
  - TRU

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Locomotive

- **Servicing**
  - Basic refuel
  - Engine inspection
- **Line-Haul**
  - Arriving and departing
    - Origination/termination
    - Set-out cars
    - Crew change
  - Adjacent mainline
    - Railroad owned
    - Other railroads with rights
    - Passenger
- **Switch (typically older)**
  - Train building
    - Classification
    - Hump and bowl
  - Short-haul or local trains within metropolitan region

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Locomotive Input Data

- **Fleet Composition**
  - Engine models (Make and Model) – Limited Emissions Data, see paper
  - Rebuild Status (Precontrolled, Tier 0, 1, and 2 engines to be rebuilt)
  - Tier IV (Low PM beginning with 2015 model year); Specially-designed switch engines may meet this early
  - Tier IV (Low PM and low NOx with 2017 mode year)
- **Activity**
  - Fuel consumption (gallons per ton-mile or gallons per engine per year)
  - Hours of operation
    - Less well known (especially outside of a yard)
    - Duty cycle – Sampling of event recorders

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Time in mode analysis (on-site)

Notch	Line-Haul Gross HP	Line-Haul Time in Mode (hrs)		Switch Gross HP	Switch Relative Time in Mode (%)
		TA/TD	Crew		
8	4,454	0.003	0.007	2,124	0.7
7	3,773	0.001	0.005	1,810	0.3
6	3,046	0.004	0.004	1,465	0.2
5	2,296	0.04	0.007	1,161	0.4
4	1,683	0.08	0.017	871	0.8
3	1,187	0.26	0.025	589	1.3
2	587	0.39	0.029	333	2.3
1	268	0.60	0.015	98	2.8
Idle	17.0	4.00	0.23	15	69.7
Dynamic Brake	28.0	0.16	0.07	82	1.3

Vessel Activity on Site

Berthing time

- Number of crews affects time on site
- Clean(er) fuel
- Shoreside (grid power)

- **Anchorages**
  - Awaiting a berth

Conclusion

- **Facilities are complex**
  - No two intermodal facilities are alike
  - Easy or else (depends on scope and detail)
  - One link in the supply chain (regional benefits but local impacts more important both economically and air quality, not unlike freeways, truck depots or truck stops)
- **Emission reduction plans**
  - Retrofit (some available but not long term experience)
  - Replacement programs (fleet turnover)
  - Activity reduction (idle shutoff, electrify or plug-in, yard redesign to reduce movements or time through the yard)