SmartWay Transport Partnership

The SmartWay DrayFLEET Model: Modeling Port Drayage Emissions and Costs

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FASTER FREIGHT - CLEANER AIR
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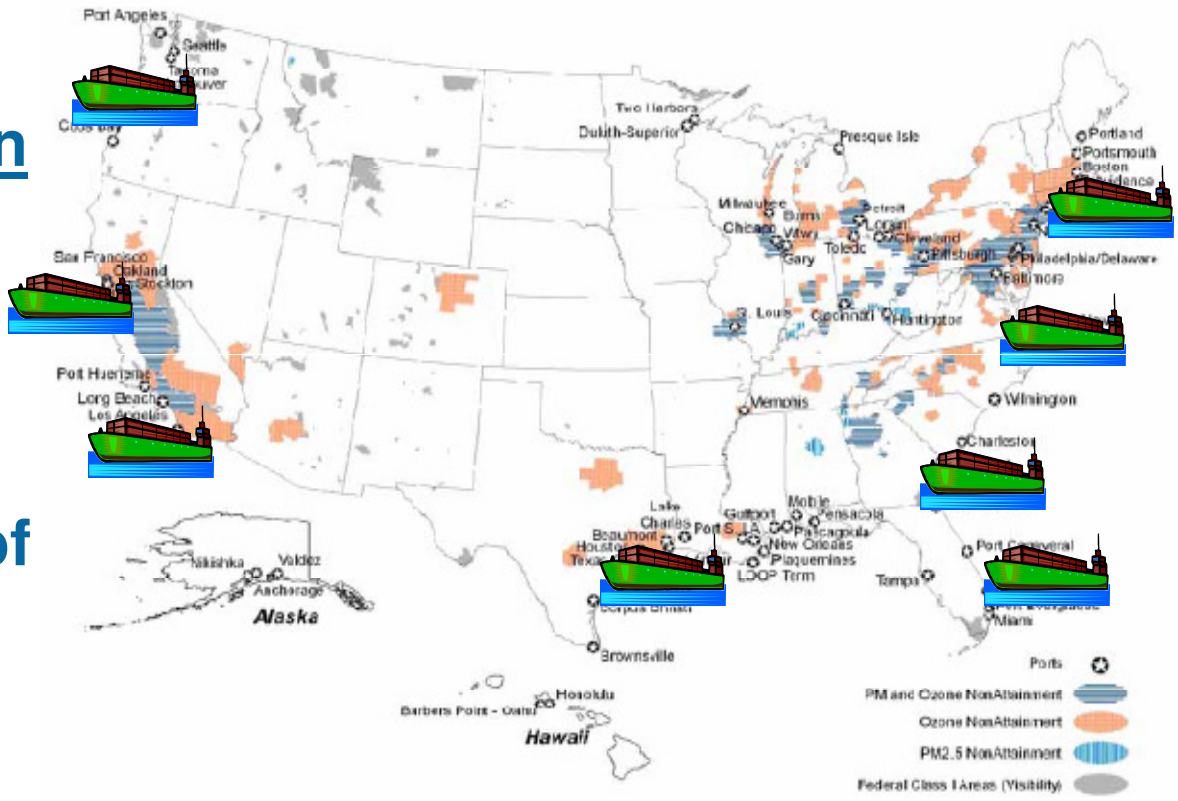
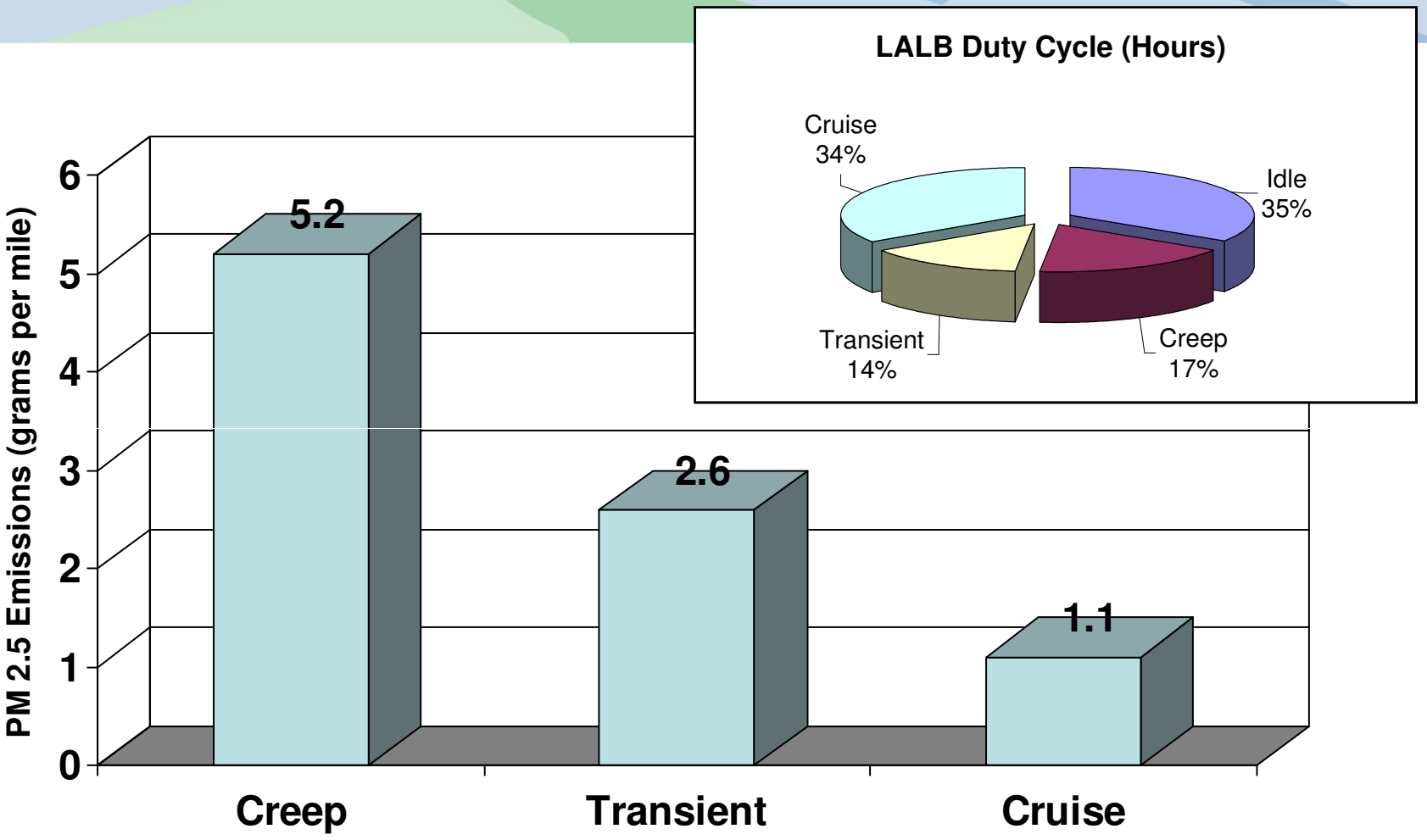
Port Drayage and Nonattainment Areas

- Ports are urban environments
- Typically older Class 8s
- Major source of PM and NOx emissions



PM 2.5 Emissions by Drive Cycle/Speed



Clark, Nigel N., et al. *California Heavy Heavy-Duty Diesel Truck Emissions Characterization for Program E-55/99.* West Virginia University Research Corporation. Morgentown: November 11, 2005

Strategies to Reduce Drayage Emissions

- Technology Solutions
  - Diesel Oxidation Catalysts
  - Diesel Particulate Filters
  - Flow Through Filters
  - Idling Control
- Terminal Management Strategies
  - Chassis Pools
  - Virtual Container Yards
  - Improved Gate Operations/reduced queues
  - On-dock rail

SmartWay DrayFLEET Model

SmartWay℠ The Smart Way to Save Fuel, Money, and the Environment

Key Stakeholders

- EPA
- DOT
- Associations
- Ports

U.S. Department of Transportation Federal Highway Administration

THE PORT OF LOS ANGELES

The Port of LONG BEACH
Your Environmentally Friendly Port

PORT OF HOUSTON AUTHORITY PHA HOUSTON, TEXAS

THE PORT of VIRGINIA 1607 2007

DrayFLEET Goals and Users

- **Goals**
  - Estimate comprehensive drayage emission inventories
  - Identify cost-saving emissions reduction strategies
  - Integrate drayage into the SmartWay supply-chain network
- **Audience/Users**
  - Port Authorities
  - Terminal Owners and Operators
  - State and Regional Trucking Associations
  - State and Regional Air Quality Agencies
  - Metropolitan Planning Organizations
- **Can support SIP modeling with additional analysis**
- **Part of Agency-wide Ports Sustainability Strategy**

Primary Inputs and Outputs

Primary Inputs

- Number of containers
- Rail intermodal share
- Distance to
  - Rail
  - Shippers & receivers
  - Container depots
- Gate queue minutes
- Labor costs
- Fuel costs

Primary Outputs

- Number of trips
- VMT
- Hours of idle, creep, transient, and cruise
- Criteria and CO2 emissions
- Gallons of fuel
- Total drayage costs
- Costs per container

DrayFLEET Input Page

Primary Inputs	Default	Scenario
Port		
Calendar Year	2007	2007
Annual TEU	15,667,504	15,667,504
[illegible]rage TEU per Container	1.85	1.85
[illegible]nd Share	53%	53%
Inbound Empty Share	2%	2%
Outbound Empty Share	57%	57%
Rail Intermodal Share	45%	45%
Marine Terminals		
Average Inbound Gate Queue Minutes	11	11
Average Marine Terminal Min. per Transaction	19	19
Rail Terminals		
Weighted Average Miles from Port	14	14
Average Inbound Gate Queue Minutes	5	[illegible]
Average Rail Yard Min. per Transaction	15	
Container Depots		
Weighted Average Miles from Port	4	
Share of Empties Stored at Depots	5%	
Container Shippers/Receivers		
Weighted Average Miles from Port	15	15
Weighted Average Crosstown Trip Miles	15	15
Cost Factors		
Average Drayage Labor Cost per Hour	$ 12.00	$ 12.00
Average Diesel Fuel Price per Gallon	$ 4.00	$ 4.00

DEFAULTS – ADJUSTED TO MATCH PORT

SCENARIOS – ADJUSTED TO TEST OPTIONS

DrayFLEET Terminal Initiatives

DEFAULTS – EXISTING STRATEGIES

Initiative Inputs	Default	Scenario
Port/Terminal Initiatives		
Stacked Terminal (% stacked)	0%	0%
On-Dock Rail (% of rail on-dock)	40%	0%
Automated Gates (% of gate transactions)	50%	0%
Extended Gate Hours (% off-peak, 50% max)	30%	0%
Container Info System (% used)	90%	0%
Virtual Container Yard (% available)	0%	0%
Neutral Chassis Pool (% used)	0%	0%

SCENARIOS – CANDIDATE STRATEGIES

DrayFLEET Technology Options

Drayage Fleet Technology Inputs*

SHARE OF FLEET USING TECHNOLOGY

TECHNOLOGIES IN USE

Technology Retrofits		
☐ Particulate Filter/Trap	% of eligible fleet retrofit	50%
☐ Oxidation Catalyst	% of eligible fleet retrofit	50%
☐ Flow-Through Filter	% of eligible fleet retrofit	50%
Idle Reduction		
☐ Idling Control Strategies	% reduction in idle	50%
Fuel Conservation		
☐ Single-Wide Tires	% of fleet	50%
☐ Automatic Tire Inflation	% of fleet	50%
☐ Tare Weight Reduction	% of fleet	50%
	lbs of weight saved	2,000
☐ Low Friction Engine Lubricant	% of fleet	50%
☐ Low Friction Drive Train Lubricant	% of fleet	50%
☐ Direct Drivetrain	% of fleet	50%
☐ Single Axle Drive (vs. Dual Axle)	% of fleet	50%
☐ Speed Management Policy (55 mph)	% of fleet	50%

Additional Detailed Inputs

DrayFLEET incorporates additional detail where available for marine terminals, rail terminals, depots, etc.

Marine Terminal Drayage Activity

This worksheet reflects movements of loaded containers, empty containers, bare chassis, and bobtail tractors to and from marine container terminals

RESTORE GENERIC DEFAULTS

Note: OB/Export Containers come IN to the Marine Terminal Gate, and vice versa

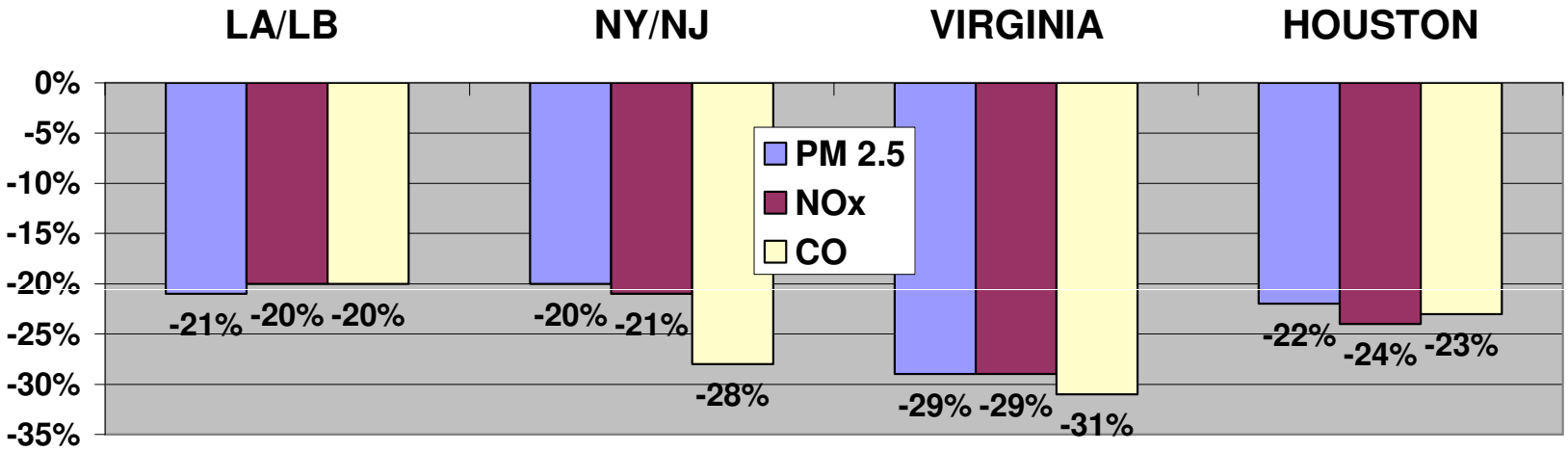
Activity	Trips	%	Duration (Minutes)	Waiting Time (Minutes)	Travel Time (minutes)	Distance (Miles)
tbound/Export Containers			= user changeable inputs			
Total Containers Entering Terminal Gate	876,334					
Loaded Containers	432,857	30%			(over-the-road movement shown on other worksheets)	
Empty Containers	443,477	30%				
Bare Chassis	145,871	10%	12	-	12	5
Bobtail Tractors	438,167	30%	35	-	35	15
Total Trips	1,460,372	100%				
Entry Gate Transactions						
Entry Gate Transaction	1,460,372	100%	3	3	-	-
Outside Queuing	1,460,372	100%	15		15	0.5
Trouble Window	73,019	5%	45	41	4	0.1
Bypass Entrance	-	0%	1	-	1	0.3
Container Yard Activity						
Pick Up Loaded Container on Chassis	548,286	27%	27	25	2	0.5
Pick Up Empty Container on Chassis	326,939	16%	27	25	2	0.5
Locate & Pick Up Bare Chassis	146,056	7%	27	15	2	0.5
Drop Loaded Container on Chassis	432,857	21%	27	25	2	0.5
Drop Empty Container on Chassis	443,477	22%	27	25	2	0.5
Drop Bare Chassis	145,871	7%	5	5	2	0.5
Chassis Flip/Transfer	8,752	0%	42	40	2	0.5
Live Lift Container onto Chassis	-	0%	27	27	0	0.1
Live Lift Container off of Chassis	-	0%	27	27	0	0.1
Total Transactions	2,052,237	100%				
Container Yard Delays						
Trouble Window	102,612	5%	30	27	3	0.1
Equipment Issue	51,064	5%	60	52	8	0.3
bound/Import Containers						
Total Containers Exiting Terminal Gate	875,224					
Loaded Containers	548,286	38%			(over-the-road movement shown on other worksheets)	
Empty Containers	326,939	22%				
Bare Chassis	146,056	10%	12	-	12	5
Bobtail Tractors	435,763	30%	35	-	35	15
Total Trips	1,457,043	100%				
Exit Gate Transactions						
Exit Gate Transaction	1,457,043	100%	3	5	-	-
Inside Queuing	1,457,043	100%	5		17	0.5
Trouble Window	72,852	5%	30	-	-	-
Bypass Exit	-	0%	1		-	
Loaded Subtotal	981,143	34%	49,447,049	31,525,762	17,921,286	970,870
Bobtail/Chassis/Empty Subtotal	1,936,271	66%	102,551,426	41,235,576	61,315,850	16,041,668
Marine Terminal Total	2,917,414	100%	151,998,474	72,761,339	79,237,136	17,012,538

DrayFLEET Case Study Results

- Four case studies: LA/LB, NY/NJ, Virginia, Houston
- Worked closely with ports to develop case study data inputs and results
- Evaluated effectiveness of existing strategies already implemented at ports – five mile impact area

Emission Reductions from Existing Management Strategies

% REDUCTION

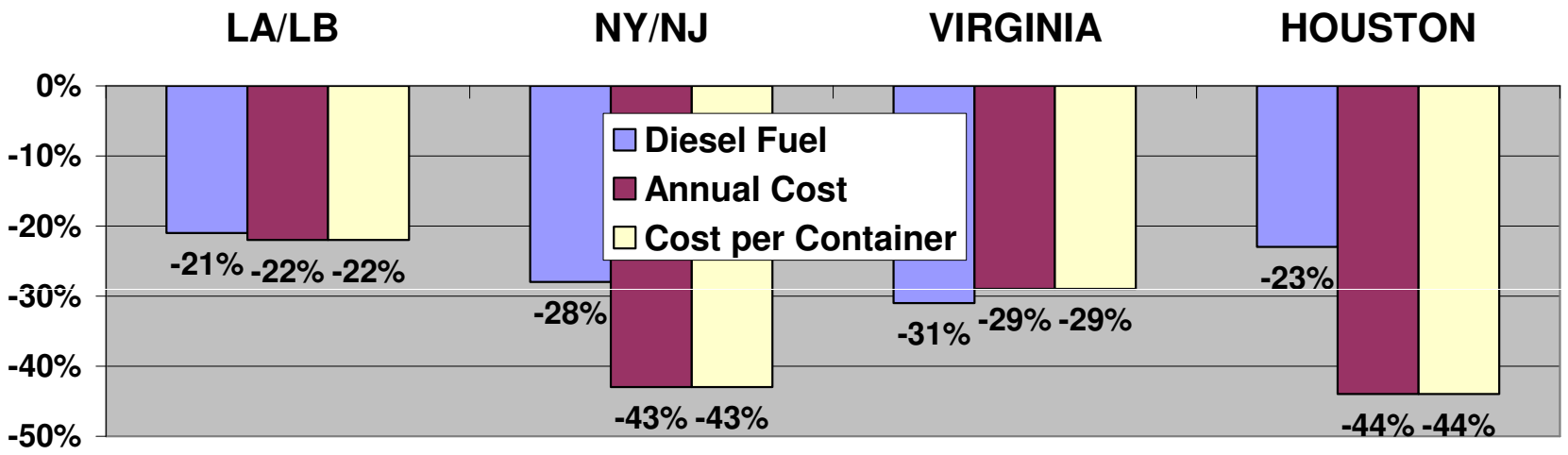


ANNUAL TONS SAVED

	LA/LB	NY/NJ	VIRGINIA	HOUSTON
PM 2.5	42	10	3	3
NOx	1,394	394	167	90
CO2	132,633	31,214	11,385	9,936

Cost Savings from Existing Management Strategies

% REDUCTION



ANNUAL SAVINGS

	LA/LB	NY/NJ	VIRGINIA	HOUSTON
Gallons of Fuel (millions)	12	3	1	1
Drayage Cost (millions)	$ 142	$ 100	$ 23	$ 32
Cost per Container	$ 17	$ 32	$ 19	$ 50

Conclusions

- Operational improvements can reduce port-area emissions by 20% to 29%, and costs by 22% to 44%
- Chassis pools, improved gate operations, and on-dock rail could substantially reduce emissions and costs
- EPA is encouraging every major U.S. port to:
  - **use the DrayFLEET model**
  - **publish a drayage emissions inventory, and**
  - **develop an emission reduction strategy**

Downloading DrayFLEET

- From EPA SmartWay
  - epa.gov/smartway/transport/partner-resources/resources-drayage.htm
- From Tioga FTP site
  - ftp://ftp.tiogagroup.com/htdocs/DrayFLEET/
  - username: drayfleet%0163e52
    password: DrayFLEET2008
- email dsmith@tiogagroup.com